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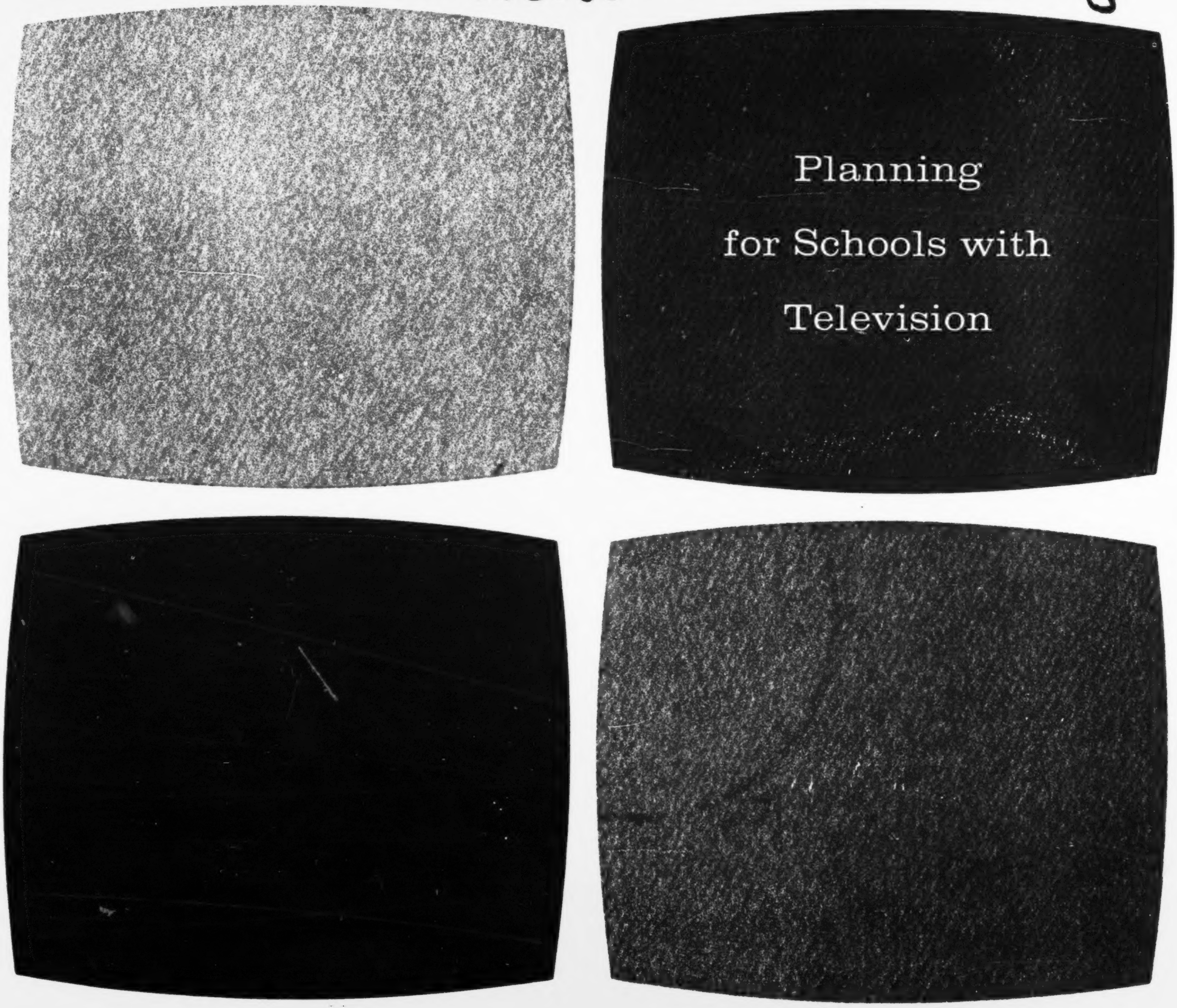

Planning for Schools with Television

EDUCATIONAL ETV

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
OFFICE OF EDUCATION

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DESIGN FOR **ETV**

Planning for Schools with Television

Prepared by
Dave Chapman, Inc., Industrial Design
for Educational Facilities Laboratories
New York, 1960

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FOREWORD

Television made its appearance in education in 1932 at Iowa State University, but it was first used for formal instruction in 1953. By 1960 half a million school and college students were receiving regular instruction by television. This rapid acceptance of a new medium for instruction meant using any and all kinds of equipment in any room available for the purpose.

As school people became more adjusted to the medium and came to regard it as a permanent tool of education, they became concerned about the environment in which television could be employed most effectively. A substantial number of educators asked Educational Facilities Laboratories to look into the problem, since EFL is an organization concerned with the things of education.

Was this a problem for a committee of educators—or architects—or electronics engineers—or psychologists—or some combination thereof? EFL concluded that it was not. It was a question of arranging things and people, and so we turned to an industrial design firm on the grounds that this was their business.

The firm, Dave Chapman, Inc., Industrial Design, which carried out the study and prepared this report, was mildly skeptical regarding both the problem and the client. They had to find out for themselves who favored teaching with television and why. They accepted no views of ours nor of the first people with whom they talked. They went to see for themselves through interviews, in meetings and conferences and through correspondence with persons in practically every state. They talked with hundreds of people—teachers, technicians, representatives of industry, students and administrators. This report presents the conclusions of more than ten months of discussions and research.

It is customary when introducing a report to disclaim any connection with the authors. We would like to do the reverse. The officers and staff at EFL have worked closely with Mr. Chapman and his staff. We feel that this is a joint venture.

Finally, we think that this report says a great deal more than how to plan new schools or adapt existing schools for teaching by television. This report says something about the dignity of teaching (and learning) and the environment in which it can best be carried out. The report also says something of the economies which come with the multiple use of space. Much of this is significant to schools whether or not they use television for instruction.

One of the unique functions of EFL is that it can bring creative experts from other fields to work on problems of education. Economic realities ordinarily restrict the use of industrial designers and other kinds of specialists to industry and commerce. This report encourages us to continue to draw on such experts for the benefit of education.

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APPROACH TO THIS DESIGN STUDY

For more than half a century architects and designers have been living with the dogma "form follows function." This Victorian half-truth offered a useful point of approach to a problem of design of physical surroundings in a cultural and social period almost stable by comparison with the pace of the 60s. But it makes the specious assumption that the *function* involved in the problem is as timeless and unalterable as brick, mortar and steel.

These lines are not written to impugn or dispute Louis Sullivan's thesis. But it is important to recognize that these times in which we live are characterized by *change*. If we understand that form *permits* function, we have a rational modification of Sullivan's doctrine. Changing functions may require responsive change in physical and environmental factors.

The design of a school, its spaces and its facilities must permit and support the educational function.

It was on this premise that we began our study of the school facilities and environmental factors related to the use of television in education at the request of the Educational Facilities Laboratories in the summer of 1959.

It was clear from the onset that it would be extremely difficult if not impossible to get a definitive statement from any one source in answer to our question "What is the educational function the school facility must support?" Basic procedures of educational practice—what is to be done, how is it to be done and who is to do it—are undergoing turbulent debate and rapid progression to new procedures.

The facts and figures relating to population growth and migration, teacher supply and availability of school facilities were scattered among varied sources. Once these were separated from opinions that had been washed over them in discussions of curricula and philosophy of education, the more immediately recognizable elements that effect our educational program began to float to the surface. We open our report with a summary of our findings in this area.

Our research meetings and seminars with both teachers and administrators do show one fact clearly.

Most educators share the opinion that proper education of our children poses such massive problems of logistics that a surgical attitude toward any and all means to achieve the desired end result is required.

Only the moving hour hand of the clock is a constant. Student enrollments, teacher shortages, facilities are all variables, as are the inter-relationships of these three elements—teacher-student ratios, group sizes and the spaces for school learning and living activities.

Regardless of curricular requirements in the years ahead, it is necessary to redeploy our students and teaching skills to greater advantage. Extension of the skills of our better teachers to more students, greater use of existing and planned school buildings, enrichment of curricular offerings all indicate increased use of audio-visual aids.

Of the audio-visual aids currently available, television appears to offer the greatest potential in the broadest areas. It is true that television has experienced erosion from a rain of mediocrity and abuse in commercial use. This in no way, however, impugns the potential value of television used properly and intelligently as an educational tool.

Our design team has studied the requirements and use of television in school situations across the nation. We have reviewed seven years of experience with educational and instructional television as developed by teachers and administrators who started from scratch with the most meager facilities and no backlog of practical knowledge to guide them.

What they did the hard way is now a matter of record worthy of review by any would-be skeptic. It is an impressive record of positive action rather than the overly-cautious debate that so often stifles any new approach to a problem. The accomplishments of the teachers and administrators and the technique itself supply a clear rationale for proceeding with this design study—to provide a guide to the design of school spaces that will complement television as one of education's tools.

It is important to your proper understanding of this report to note that our study is substantially diagnostic in character. It is neither an architectural nor an engineering manual. In verbal and visual sketch form we offer comments, recommendations and suggestions to serve as a *guide*. You must put the notes in context with your particular school planning situation. We highly recommend that you bring in able, professional assistance to deal with details of the technical problems in carrying out action steps suggested.

Dave Chapman

With all deference to hundreds of sideline issues, one problem in U. S. education today is paramount.

As of this moment, there are more students to be educated than we can handle effectively by current techniques of teaching and administration. The pressure of sheer numbers promises to get worse, not better, in the years ahead.

It is clear that our standards of education must not only be maintained but improved. Both the procedures and the facilities of education must be re-evaluated in the light of current and future demands.

The primary focus of this study is the facility for the educational program—spaces and equipment for learning in the school. Particular emphasis is placed on the effective use of television in the classroom.

What should a teaching-learning space look like? What should it include? As pointed out in the introductory notes, a well-designed school facility must allow for the function it serves. The school must serve the student, the teacher and the school organization. Before planning and designing spaces for education, the design team undertook a diagnosis of the problems involved. Some of the basic elements follow.

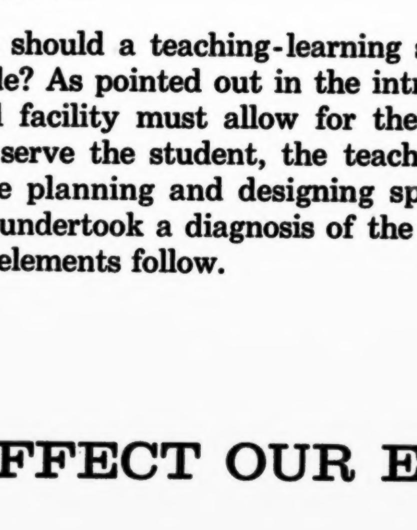
ELEMENTS THAT EFFECT OUR EDUCATIONAL PROGRA

...about the student

current

Almost 47 million persons are receiving some sort of schooling in the U.S. today (more than 1 out of every 4).

Public elementary and secondary schools alone are carrying a load of more than 36 million enrollment. An additional 6 million youngsters are in independent and church related schools.



future

The student population will continue to increase dramatically in the years ahead. There is every indication that the rate of 5.4%–7.4% annual growth in numbers of students over the past 10 years will continue and, indeed, may even increase.

By 1965 it is estimated that public school enrollment will top 41 million, while the national population grows to more than 190 million.

. . . about the student *(continued)*

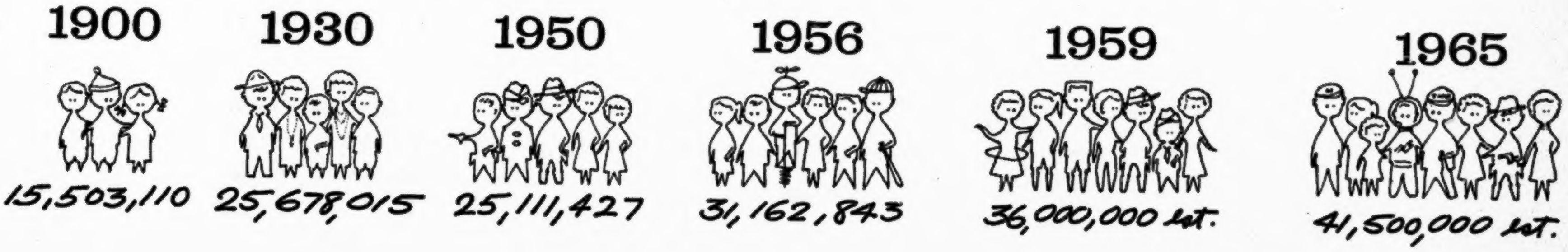
Current

It is estimated that some 38% of high school graduates in 1958 enrolled for further education. College enrollments in 1959 hit a peak of 3.4 million.

future

By 1970 it is estimated that 44% of all high school graduates will continue their education, swelling college enrollment to more than 6.4 million students—almost double the 1959 enrollment.

Public School Enrollment



The student today wants, needs and actively seeks an education to prepare him to cope with problems he meets in an increasingly complex society—a society much more complex than the world his parents grew up in.

Motivation studies show that at least to age 9–10 the youngster has an intensive drive to learn to read, write and speak so that he can communicate with an adult society in which these skills are a norm. *At this age he is generally capable of absorbing more education than we often offer him.*

At least to age 16 (often to age 18) a student *belongs* when he is in school. If he drops out of school before this age he is an "odd-ball," out of his social element and ill prepared to compete for even the most menial job assignment.

His motivations to learn are not as intense in the teens. Beyond the basic subject matter, this student must also be taught *why* he should work on his education. As the general level of education in our society continues to rise, the job of motivating the student will become less difficult.

Percentage of Youngsters Ages 5-17 in School

1900	69.3
1930	80.4
1950	90.2
1956	92.5
1958	93.4
1965	???

The pressures of a society with higher educational standards and higher demands for mental skills will naturally motivate the student's desire for more schooling to keep up with his associates and competitors.

Tomorrow's students at all ages will take on more responsibility for their own learning. Studies now limited to higher grade levels will be undertaken at lower levels (such as foreign languages, mathematics, some science studies).

More attention will be given to the individual pacing of a student's study program according to his ability and readiness to learn.

Within the near future a *normal* schooling period for almost 100% of our youngsters will be 12 years.

The rapid growth of Junior or Community Colleges will make a 14-year schooling period a much more common educational background.

. . . what is to be learned

Current

The body of knowledge with which our society must cope has increased at a staggering rate since the turn of the century.

Keeping abreast of daily changes in social patterns, technological advances, developments in the fine arts and behavioral sciences offers a challenge for the reporter—to say nothing of the student and teacher.

Both the learning and teaching tasks have grown so fast that current teaching techniques and facilities have been left behind.

future

The rate of growth of our body of knowledge is a steadily rising curve and a steep one.

Aided by complex electronic data storage and processing machines, our theoretical calculations and storehouse of knowledge will grossly outstrip our ability to apply-to-practice in the near future.

This vast fund of knowledge will probably be more than current standards of mental ability can digest.

If more of this knowledge is to be made available to the student through our schools, a rearrangement of curricula and teaching techniques will be necessary.

. . . about the teacher

Both quality and quantity of our teaching force have grown enormously in the last 25 years.

. . . But the size of the teaching force has not kept pace with the demand of the exploding student population.

At the opening of the 1959–60 school year a total of 1,563,000 teachers was needed in both public and non-public schools. Qualified (certificated) teachers available numbered 1,368,000—*a deficit of 195,000 teachers.*

There is no indication at present that there will be an adequate increase in the number of teachers available to match the upward spiral of enrollment figures clearly calculated for the years to come.

Major changes in the pattern of utilization of our teaching skills will take place in response to the pressing demand of the situation. Increasing use of instructional aides, clerical assistants, and other non-professional personnel will help to free teachers for teaching.

Teacher Supply
and Demand (est.)
1959-1960

A. Qualified teachers of the preceding year returning to classroom service.	
Total classroom teachers (1958-59)	1,493,000
Less teachers with substandard credentials in public schools (1958-59)	92,300
Qualified classroom teachers (1958-59)	1,400,700
Less qualified teachers not returning to classroom service (1959-60)	152,700
Qualified teachers returning (1959-60)	1,248,000
B. Newly trained teachers entering classroom service.	97,000
C. Teachers with substandard credentials becoming fully certificated	23,000
Total qualified teachers AVAILABLE for 1959-60	1,368,000
Total NEED for qualified teachers for 1959-60	1,563,000
Total qualified teachers AVAILABLE	1,368,000
Total SHORTAGE which must come from other sources	195,000

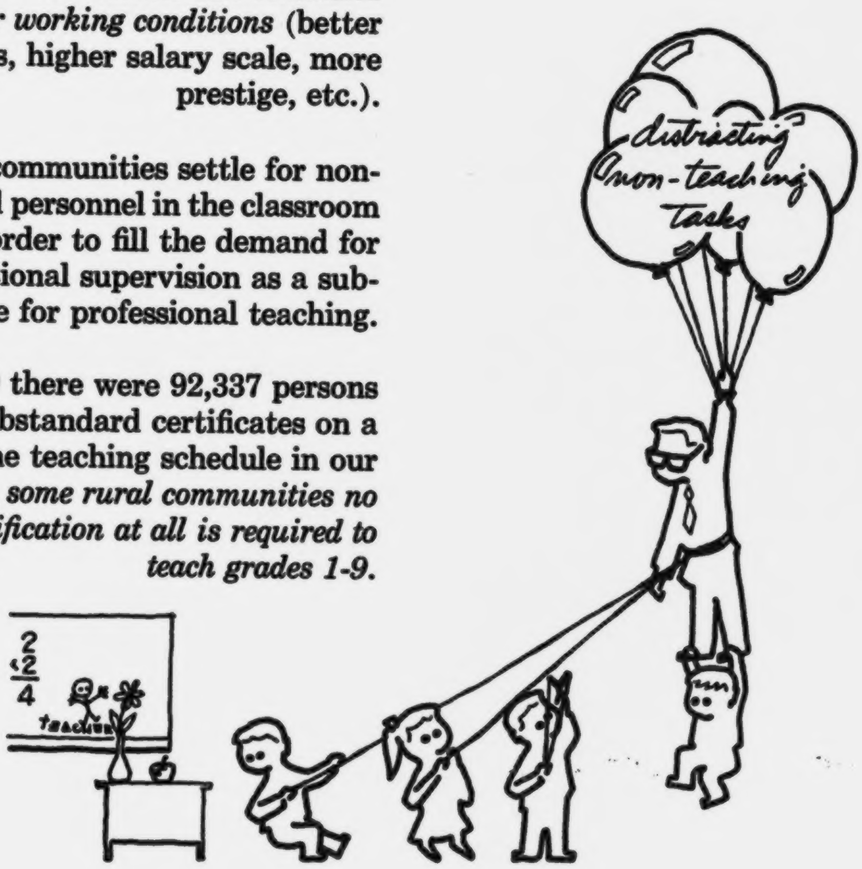
... about the teacher *(continued)*

Current

Demand for and shortages of teachers is in one major respect more a local than a national problem—*better teachers generally gravitate to areas where their talents can command better working conditions* (better facilities, higher salary scale, more prestige, etc.).

Some communities settle for non-certificated personnel in the classroom in order to fill the demand for educational supervision as a substitute for professional teaching.

In 1959 there were 92,337 persons with substandard certificates on a full-time teaching schedule in our schools. *In some rural communities no certification at all is required to teach grades 1-9.*



Clerical and housekeeping chores often eat up 30% to 60% of the teacher's routine working day. Some schools are using student and community assistants to relieve the teacher of these irrelevant and distracting duties. Electronic machines are also being called into service to grade tests, prepare schedules and report cards, record attendance and perform other routine tasks.

future

Educational planners across the nation will translate into action the plans (a) to utilize existing teacher skills more effectively and efficiently; (b) to encourage qualified teachers to remain in the field rather than moving into better-paying jobs in industry; (c) to encourage more young people to enter the teaching profession; and (d) to bring capable outside talents into the teaching world to assist and supplement the permanent professional staff.

As competition between communities to snap up better teachers increases, the teacher's salary scale will generally rise. There will be an upgrading of education in some individual communities that continue to buy better teaching skills at a higher price—but higher salary scale will not in itself solve the problem of shortage on a national scale.

Experienced teachers will spend more time teaching and less time at clerical and housekeeping chores that can be handled by aides with less experience.

Many of the strictly clerical procedures will be handled by efficient machines and trained clerks.

The most advanced communication devices at our disposal—especially television—hold great promise for spreading the impact of our leading teachers to more students.

... schools and administration

The U.S. school system is the biggest business in the nation short of the government itself.

The system has more employees (more than 1½ million), more active "customers" (in excess of 47 million

The U.S. school system by 1965–70 will be even bigger than it is today.

The number of students of all ages will probably top 52 million. There will be many new schools constructed—but the total number

. . . schools and administration *(continued)*

Current

students), and more "branches" (more than 140,000 schools) than any single private enterprise.

Change in policy or procedure is extremely difficult to effect on a nationwide basis. There is no central "boss" or agency with authority for broad control or administration of policy or practice. Standards of effectiveness and efficiency are determined autonomously by almost 200,000 members of 49,477 boards of education.

There were roughly 25,000 one-teacher schools in the U.S. in 1958. These very small schools are almost exclusively in rural areas.

At the other extreme, some of the larger urban areas report a trend toward elephantine high school enrollments. At last check New York City had two high schools with enrollments of more than 6,000 students each. The 3,000 and 4,000 student high school is not unusual in larger cities and suburbs from coast to coast.

Small schools—especially at secondary level—find it difficult to provide the physical facilities and/or teacher skills necessary to offer a well-rounded curriculum.

Thousands of rural communities, for example, cannot offer a high school course in physics or chemistry—no teacher for the subject; no equipment; not a large enough enrollment to make the course economically feasible without raising instructional costs out of reason.

Even in larger cities, it is not uncommon to find several schools sharing the services of a teacher specialist in such fields as music, art and foreign languages.

future

will remain about the same due to consolidation of school districts. In this consolidation, many small schools which are inadequate to deal with ever more complex problems will be blended for efficiencies at all levels—teaching, administration and fiscal functions.

Consolidation: Public Elementary and Secondary Schools

	NO. OF ONE-TEACHER SCHOOLS	TOTAL NO. OF SCHOOLS
1951-52	50,742	147,509
1955-56	34,946	130,473
1957-58	25,000 est.	121,700 est.

In urban areas where secondary school enrollments are inclined to be large, new school plants will often be based on the school-within-a-school plan to avoid depersonalization.

Four elements of 500 students each, for example, may be arranged around a central core unit. All can share some facilities scaled to a 2,000 enrollment (i.e., gymnasium or field house, auditorium, science and language laboratories, kitchens, etc.). Administration of each unit, however, will remain comparatively independent. From a teaching standpoint, such a plan allows greater flexibility in dealing with the individual student on his own level.

Large-area television broadcasts of courses that require specialist teachers and facilities can bring courses to small schools that might not otherwise be available to the students.

Video tape recording equipment will be available in a price range that will make it feasible for the comparatively small school to own its own equipment. On this basis, the small school will set up its own distribution program at its

. . . schools and administration

Current

The average expenditure per pupil across the nation in the 1958–59 school year was approximately $340 (closer to $440/student if you realistically include capital outlay, interest, current plant expenditure, etc.).

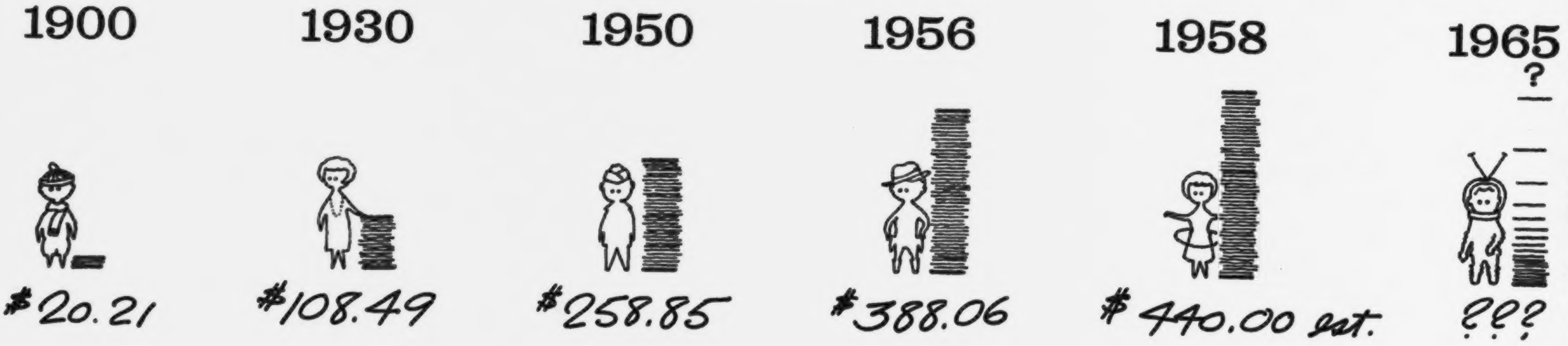
future

own schedule, drawing from a taped library of lessons to fill whatever gaps may appear in its curriculum.

The costs of education will rise steadily in the years ahead—probably at a more rapid pace than the cost-of-living index and closer to the rate of rising individual income.

Annual Expenditure Per Pupil

In Average Daily Attendance In Unadjusted Dollars



TEACHER-STUDENT-SPACE RELATIONSHIPS

Education involves *people* and *things*. In the step-by-step study leading to design of space in the school and the educational tools and furnishings in that space, the design team next asked the question "How are the people and the things of education related to each other; how do they best function together?"

Here, too, it is difficult to define a distinct pattern of relationship. No two schools surveyed worked by identical patterns or schedules. No two teachers seemed equally skilled in or inclined toward the use of the facilities or teaching aids at their disposal. While this was disconcerting, it was to be expected in a situation with so many variables of personalities, administrations, communities and climates.

If not identical, at least general patterns do exist in the relationship of the student, the teacher and the group. First, there are patterns of groupings and movements of the students and teachers within the school according to the age and/or mental advancement of the student. Second, there are patterns of teaching-and-learning techniques related to group sizes. Third, there are patterns of space requirements directly related to the logistics of group sizes.

The way these patterns are formed distinctly affects the facilities and design of school spaces to accommodate the teaching-learning process. (Note: For purposes of semantic and graphic clarity, we refer to these groupings as "grades K, 1, 2," etc., in the following notes. We are aware that some educators suggest complete elimination of the traditional grade classification of students.)

Elementary School Levels

through grades 5, 6, 8 or 9, according to individual community plan of programming

Current

The world of the student and teacher is generally one room where they remain together for the larger portion of each day. In grades K, 1, 2, 3, the student has little occasion to leave the direct supervision of the teacher for more than a few minutes at a time.

The teacher is responsible for covering a variety of subjects as well as supervision of playground and snacktime activities. In some cases a specialist teacher visits periodically for feature sessions in music, art, psychological testing, etc.

As the grade level gets progressively higher, movement from the base room is more frequent, with trips to the library, gymnasium, cafeteria and into the community—occasionally to the art, music or multi-purpose rooms if such special facilities are available. Classrooms in most elementary schools today are ordinarily rather unimaginative square or rectangular boxes with equally unimaginative facilities and furnishings.

K
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2
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4
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6 6
7 7
8 8
9 9

future

At all levels of elementary education steps will be taken toward more individualized attention to student needs and abilities. Team teaching techniques will bring the student into contact with more than one teacher. Several teachers will share the responsibility of the day's schedule —each handling the area of teaching for which he or she is better qualified.

Increased teacher specialization from grades 4 and up will be especially important. Rather than remaining in one space all day long, the student and/or teacher in the primary grades will be more inclined to move about the school plant. A greater variety of school spaces will be required. Sometimes children will be grouped with other than their classes, either in larger or smaller groups.

More attention will be given to *humanizing* the elementary school and its spaces. Since the youngster of ages 6–14 is extremely impressionable, the trend will be away from the "institutional look."

Secondary School Levels

grades 5, 6, 8 or 9 through grades 12, 13, or 14 according to individual community programming

Secondary school plants are normally larger than elementary plants in size, enrollment and scope of curriculum. On a national average there is one high school for each 5 elementary schools.

Except in the smallest high schools, the secondary school teacher specializes in one or two subjects. The student may have a homeroom for a base of operations; but he generally moves from room to room as his subject of study changes through each day.

Rooms equipped with special teaching aids for one or two subjects are used as a base of operations for each teacher. Specialized teaching equipment and spaces as well as more-specialized teachers are more distinctly required at secondary than at elementary levels.

Today's secondary school generally has too many boxes for 30–35 students and a teacher, not enough spaces for individual study, small group work and large group instructional training.

5 5
6 6
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16

Tomorrow's secondary school will take into account current concern with growth in size, enrollment and loss of student-teacher contact.

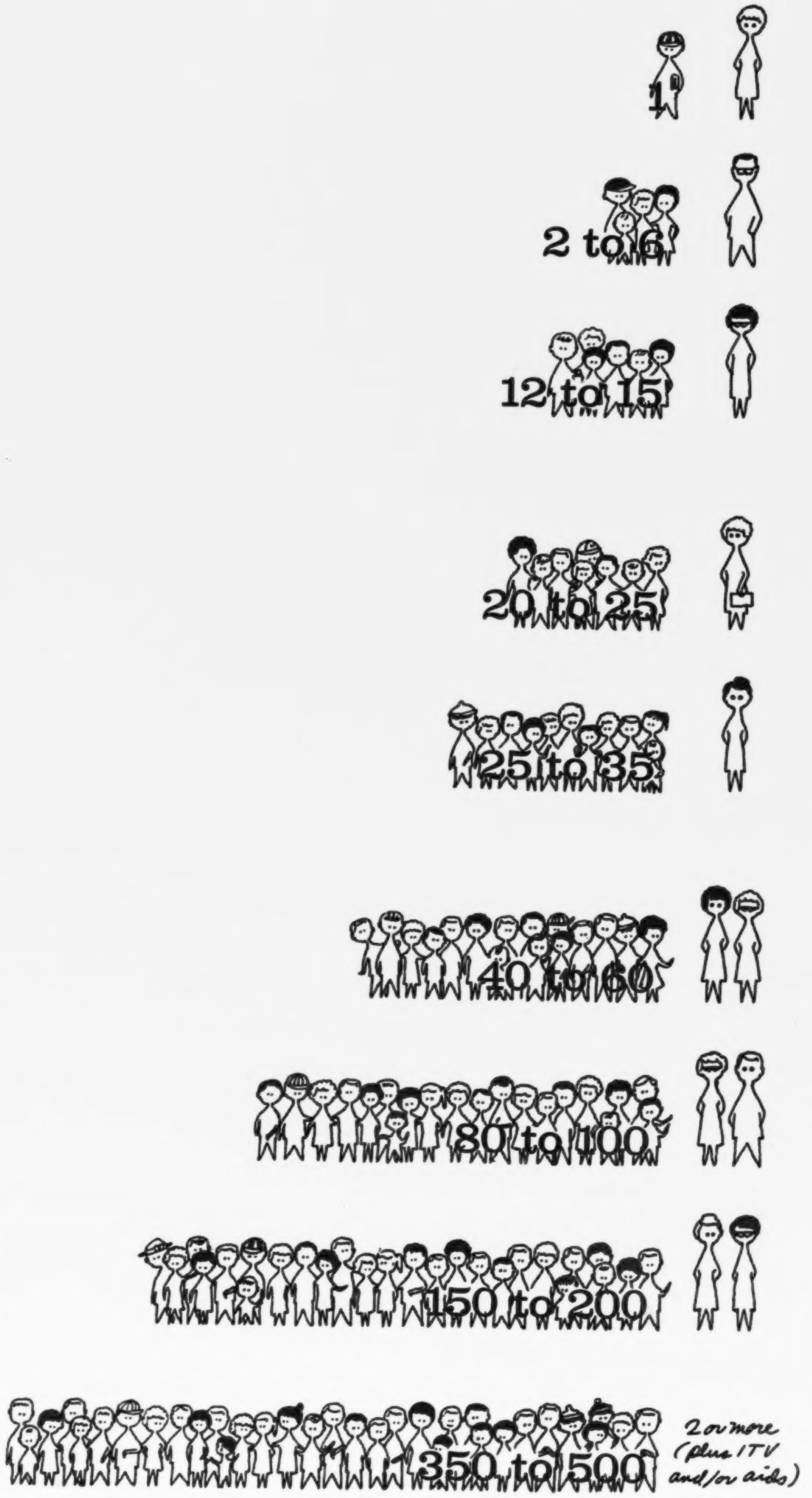
The student will carry more responsibility for self-initiative, as he will when he goes on to college. His motivation toward accepting this responsibility will be encouraged by increased small-group instruction and counsel.

By readjustment of the grouping pattern, a teacher will meet with more students and still have more time for preparation of lessons. With the help of electronic devices such as language laboratories, television, etc., expert teachers will be shared by more students. Team teaching procedures will utilize the individual teacher's particular skills more effectively.

Spaces in the school will be designed for activity in more varied group sizes—for the individual, small groups (4–5), seminar groups (10–15), more traditional groups (25–35) and large groups (50 and up).

Group Size as it Affects the Teaching Technique

group size — no. of Teachers — Teaching techniques



Highly individualized teaching and guidance is the great advantage of the 1:1—1:6 teacher-student ratio. *Instruction* in small groups is subordinated to *motivation* of the student—motivation first to ask the question and second to seek his own solution. Here the teacher's most valuable function is encouragement of the student to help himself.

In the seminar-type group a teacher is perhaps most valuable as a catalyst. As in very small groups, here the teacher tends to lead the students rather than instruct. Close contact between teacher and students as well as between one student and another (with or without a teacher present) allows for "team learning".

There is open debate among educators about the degree of real individual contact between teacher and student when the ratio goes beyond 1:20 or 1:25. The average teacher-student group ratio today is about 1:26 in our public schools—higher at elementary levels, lower at secondary levels. Overcrowding has made the ratio of 1:40 or 1:45 unfortunately common across the nation. Personalized contact between teacher and student is difficult at best. More emphasis is placed on instruction than open forum exchange.

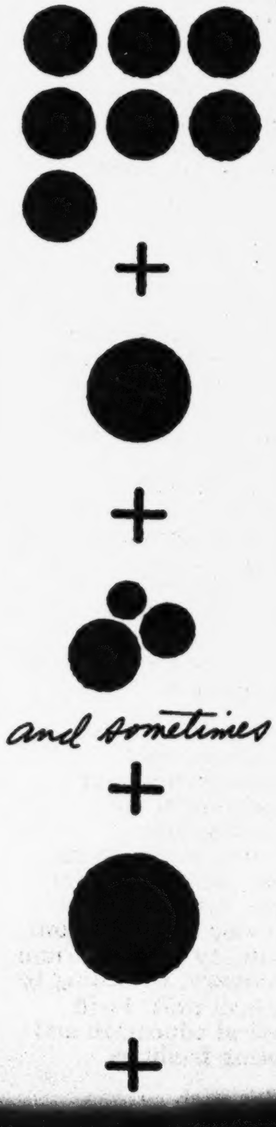
It is generally agreed that once the group has gone beyond the 40 mark, basic teaching techniques do not change appreciably, regardless of group size.

More specialized skills of teaching are necessary, with more explicit attention to preparation of instructional material since there is less occasion for give-and-take between teacher and student. Many educators debate the real immediate instructional value of student participation in large groups except for delivery of planned presentations.

Teacher emphasis for large groups is on instructional material in the subject area. Teaching aids are extremely important for both audio and visual demonstration or amplification in large group delivery. Teaching teams (a lead teacher plus support teachers and/or clerical aides) have been used in teaching such groups, often supported by televised programs of instruction and other audio-visual aids.

Elementary School Spaces

Current



Regular classrooms for 25-40 students generally make up the majority of spaces in today's elementary school. The teaching-learning process calls for great variety of groupings for students of varying abilities. The basic rectangular shape, lacking facilities for subdivision, frustrates need for varied groupings of students.

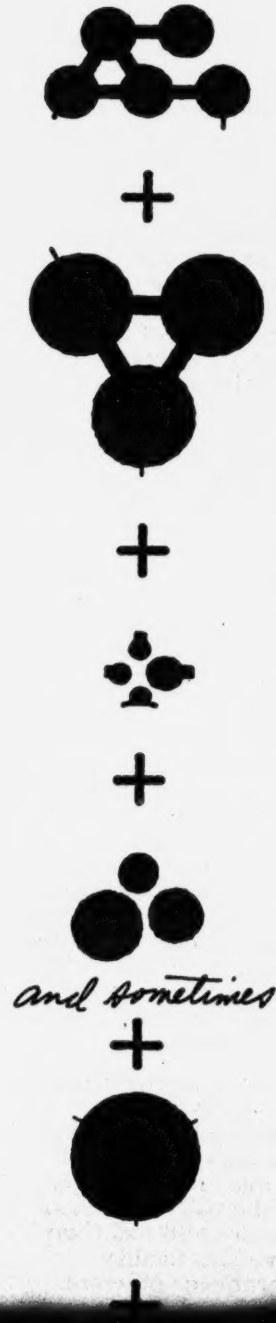
Large multi-purpose spaces for 60 or 75-100 students are more common in our newer schools than in older plants. Newer elementary schools may include a small gymnasium or playroom, a multi-purpose room, cafeteria or lunch areas, sometimes a library, art, or music room. Some older schools remodel to combine two standard classrooms into one larger multi-purpose space.

Other necessary facilities and spaces include reception and administrative offices, washrooms, teacher's lounge and dining room, clinic spaces and occasionally spaces assigned to (but seldom designed for) special student counselling. Often the clinic serves double duty as a supply depot and file room.

Auditorium facilities for 150 or more students are most often combined with gymnasium facilities in the elementary school, to be used on days when the weather does not allow use of the outdoor playground. To serve this dual purpose, the floor is generally flat and ceiling high; seating is movable, often folding, seldom comfortable. General evaluation:—such space rarely serves either function well, since it was designed specifically for neither.

Outdoor spaces immediately adjacent to the school are rapidly being overgrown

future



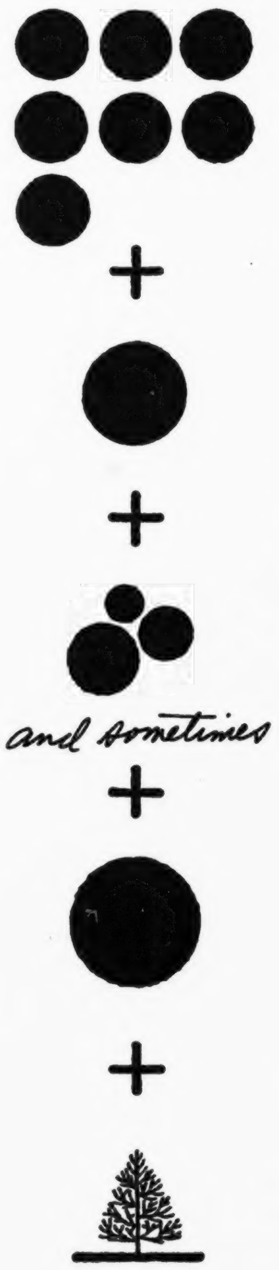
Tomorrow's elementary schools will have fewer standard classrooms and those will be designed for somewhat smaller groups of 20-25. Smaller rooms will often be adjacent to each other with operable partitioning devices to allow combinations of 2 or 3 rooms when desired. Use of space dividers and movable furnishings within each room will allow for variation of group arrangement.

Two or three large-group spaces will be included in most well-planned schools of the 60's. These spaces will be designed for great versatility of grouping arrangements. Library, music rooms, arts and crafts room, little theater, playrooms, will all fall into this category. Proper choice of furnishings and proper installation of audio-visual resources will be necessary to the effective function of the spaces. Intelligent multiple use of some of these spaces will be common.

Special-use facilities will be more specifically designed for their particular function. When feasible, the teacher's studio or office will be situated near a teaching space and serve for individual counselling and seminar study area. Use of special furnishings, colors and furniture in these areas will emphasize the warm, human relationships they must engender—avoid the institutional look.

Other necessary facilities and spaces will not change greatly from those in existing schools. But, like special-use facilities, special attention will be given to making these areas more pleasant, less institutional.

Auditorium and cafeteria for 150 or more students are being combined as a "cafetorium" in many new elementary plants. When specifically planned to serve these two compatible functions as well as for large-group instruction, such space can be an economically feasible part of a comparatively small plant. Acoustical and sight problems will get special expert attention in these spaces, along with proper choice of furniture and furnishings.



Regular classrooms for 25-40 students generally make up the majority of spaces in today's elementary school. The teaching-learning process calls for great variety of groupings for students of varying abilities. The basic rectangular shape, lacking facilities for subdivision, frustrates need for varied groupings of students.

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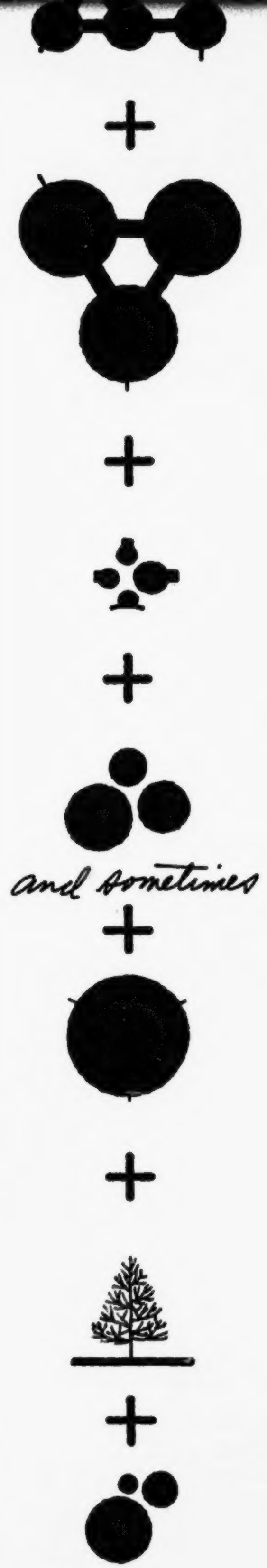
Outdoor spaces immediately adjacent to the school are rapidly being overgrown with parking lots in both new and old schools, especially in urban areas. Whatever space is left over after consideration of cars, busses and delivery trucks may be delegated as playground. Outdoor areas are seldom provided or furnished for academic activities.



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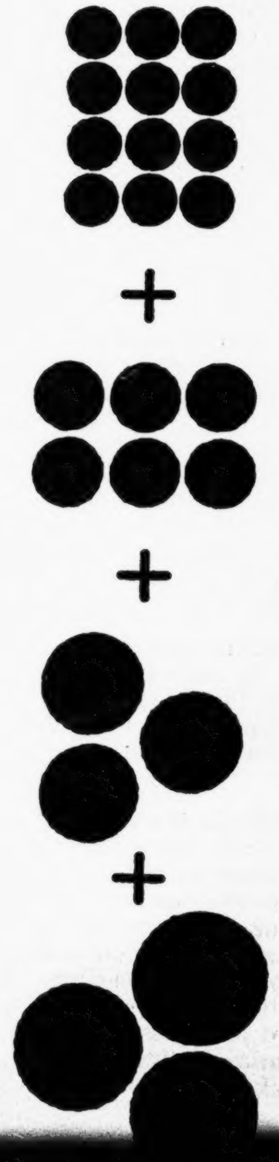
Outdoor spaces will be more jealously protected from encroachment of the flow of asphalt and cement. Especially where climate allows, outdoor provisions will be made for academic as well as physical education. Many class spaces will have doors opening directly to the outdoors as well as to inside corridors. Courtyards between wings of the school will receive more attention in planning and use.

Television studio facilities for originating instructional and educational television programs may be built into one school, shared by several nearby schools linked together by transmission cables.

Secondary School Spaces

current



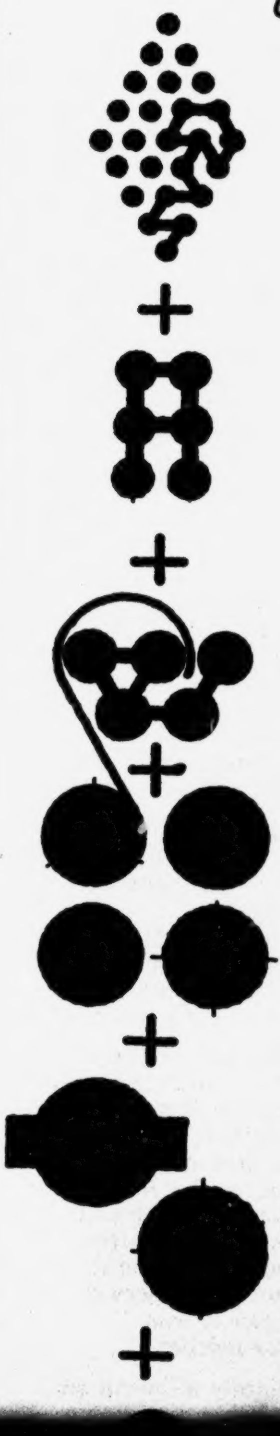
Regular classrooms for 30-35 students generally make up the majority of spaces in today's secondary school. In larger schools each room may be assigned to one or two teachers for one or two subjects only, allowing for permanent installation of teaching aids and equipment in that room. Since students come and go at the end of each period, there is not much opportunity for rearrangement of the room facilities. If rooms are unimaginative at the beginning of the day, they remain that way.

Special educational spaces for 30-35 students include such rooms as science labs, homemaking arts rooms, shops, business training rooms, art rooms, etc. Since these are planned specifically for special studies, they are normally much more conducive to creative teaching and learning. Some schools today are introducing rooms especially designed for the encouragement of both slow and rapid learners to advance at a pace more compatible with their potential.

Vari-purpose rooms for 75-150 students include study halls, large lecture rooms, occasionally a library. In overcrowded schools or schools too small to allocate cafeteria space, the vari-purpose room may serve as a lunchroom as well. Since these rooms seldom have facilities beyond desks and chairs, there is little chance that more than one teaching-learning situation will exist simultaneously—the room is either entirely quiet for study, at attention for lecture or at ease for socializing.

Auditorium, gymnasium and cafeteria are individually and collectively the most expensive and extensive areas of the U. S. high school today. In spite of the fact that auditoriums are frequently used less than 10% of the time the school is open, most communities still feel their high school should have this facility. Acoustical and sight problems inherent in more traditionally designed spaces such

future



Individual study spaces for 1 or 2 students, with or without the presence of a teacher, will be almost anywhere—the library, a special area set apart in a larger classroom, a sound-protected booth, a laboratory or shop, a teacher's office, etc. Tools for self-instruction should be accessible—books, lab equipment, sound recorders, television, drawing materials, projectors, etc.

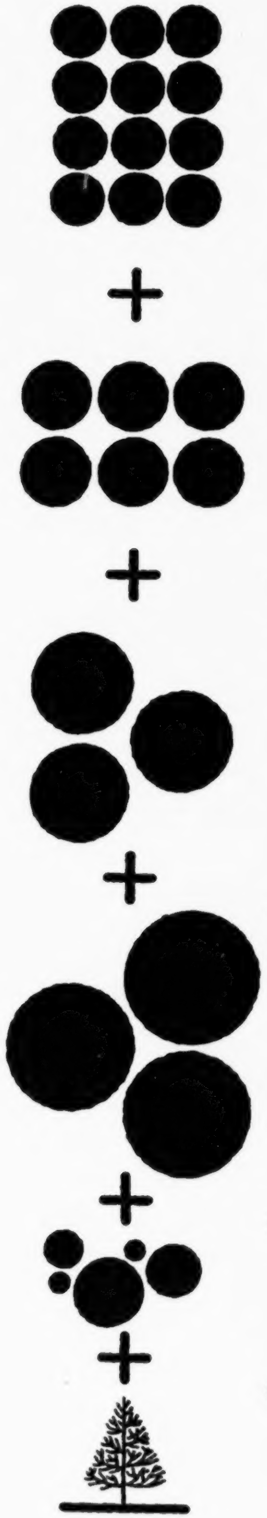
Seminar spaces for 12-15 students will be common facilities in the secondary school. Conference and seminar rooms will be more casual, less restrictive than standard classrooms, providing space and facilities for work projects and teaching aids. These spaces should have distinct personalities—living rooms, lab areas, historical settings, etc. Partitioning devices should allow expansion or enclosure of space-within-space.

Classrooms for 25-35 students will be included in most new school plans to satisfy more conventional teaching techniques. If these rooms are either conventional rectangles or less-conventional shapes to better accommodate their function, they can be so arranged as to allow for combinations into . . .

. . . large-group rooms for 75-150 students. Movable partitioning devices capable of satisfying problems of sight and sound will make the conversion possible. Large-group arrangement will allow for lecture-type instruction, televised instruction with multiple screens and the uses of other team-teaching techniques.

Large multi-purpose areas for 150 or more students will accommodate groups for lecture, demonstration and televised instruction. Additional use of space for cafeteria, auditorium (cafetorium), small theater, music room, library, study areas, etc., is indicated for efficiency in use of space. Acoustic planning and freedom from visual obstructions is important. Sub-divisibility of auditorium may or may not be necessary, according to the size of the entire school unit. Field house will provide physical education and possibly all-school meeting facilities.

Other necessary facilities



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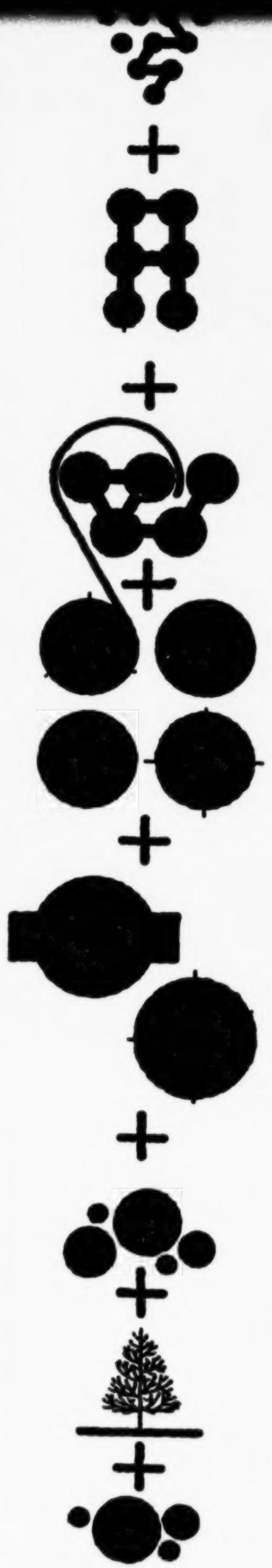
Other necessary facilities and spaces include reception and administrative offices, washrooms, staff lounges and dining areas, materials and equipment centers, health center and occasionally spaces for special counselling or enrichment programs.

Outdoor spaces are not often used for academic activities today, but there is a definite trend in new schools toward planning concourses and commons areas for clear-weather lounges and meeting spaces. Parking facilities for both staff and student cars pose a major problem.



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Other necessary facilities such as those currently required will be given more detailed attention in planning both for efficiency in use of space and for more pleasant environmental effects.

Outdoor spaces will be utilized more often as teaching-learning areas. Attractive exterior treatment of the spaces around the school has great value in bolstering student and community pride.

Television studio facilities for originating programs as well as short-run transmission from video tape and film will be included in many new schools. Studios will vary in complexity according to the needs of the school program.

FLEXIBILITY

". . . And time yet for a hundred indecisions
And for a hundred visions and revisions
Before the taking of a toast and tea."—T. S. Eliot,
"The Love Song of J. Alfred Prufrock"

But will there be time? How many indecisions and revisions in the name of visionary planning of the educational facility? And at what costs of both time and dollars?

The Eliot reference reflects the major pitfalls of educational planners working with architects in drawing up specifications for the new school. Who must decide the architectural format of the school—the architect or the educators? Certainly both share in the responsibility. But to what degree does each determine the end result?

Let us repeat our opening thesis: *The well designed school must serve the needs of the educational program—student, teacher and administration.* It is clear that the educational specifications must come first if the structure is to serve the program. Creative architects are generally pretty bright people. But not even an architectural genius can solve a building problem before the problem is clearly stated.

Of the two needs—for educational planning and architectural planning—the first is undoubtedly the most difficult to satisfy since it deals entirely with the elusive elements of people-problems. Philosophies and theories, opinions and attitudes, experience and conjecture are all involved. Out of the frustration and indecision in trying to establish a people-oriented plan of educational programming, one term has emerged as a real escape clause to toss from school planners to the architect—*FLEXIBILITY.*

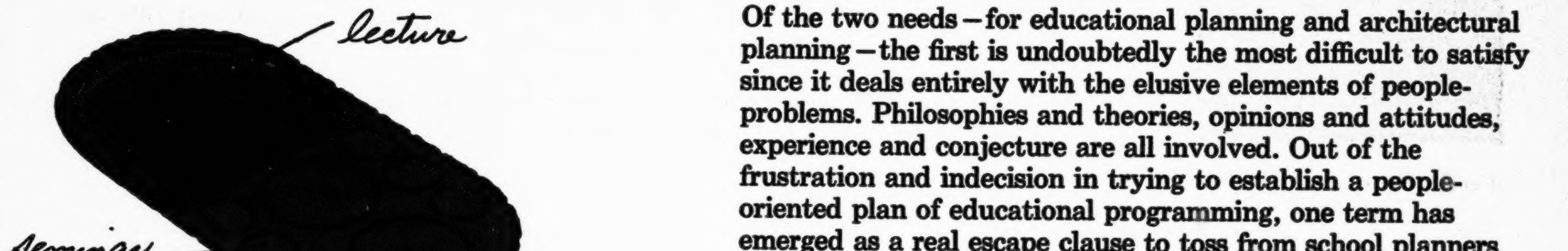
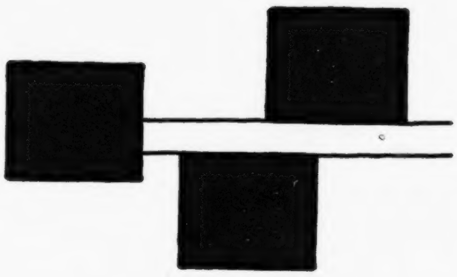
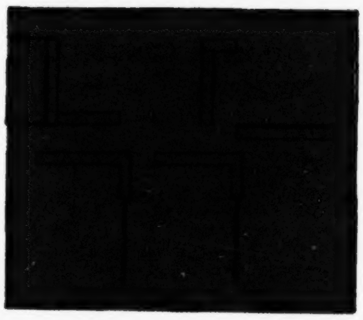
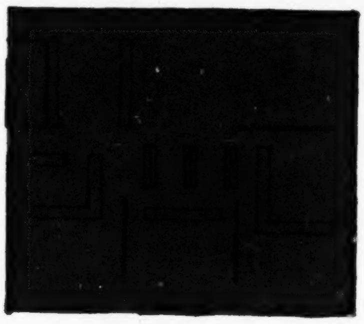


Diagram of Educational Pattern Trends in Secondary Schools

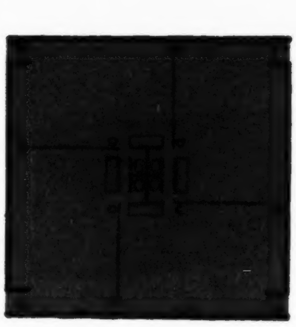




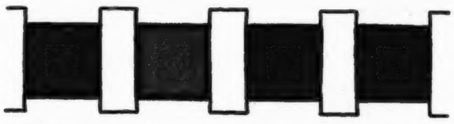
flexible School unit – movable furniture



Regional Elementary School, Hebron, Conn.



flexible School unit – operable partitions



Elementary School, Laredo, Texas
Architect: Candill, Rowlett, Scott & Assoc.

"We want flexibility in our schools." There are synonyms that also set the die of indecision – convertible; adaptable; divisible; sub-divisible; movable; removable; changeable; multi-purpose; vari-purpose; and more of the same.

Any of the terms can be useful and meaningful if we can determine what degree and variety of flexibility we want and what we are trying to achieve with it. On the other hand, any of these words can be used to cloak indecision about educational planning and required facilities.

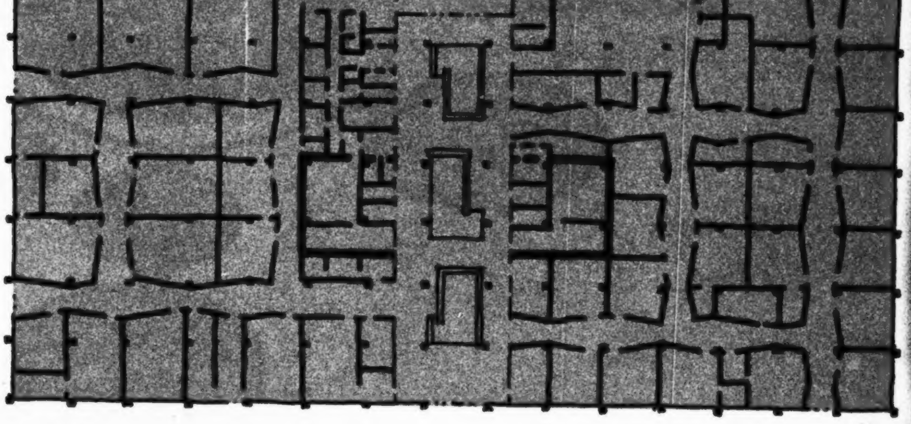
Are we talking about *additions to the main plant* to meet a future pattern of enlargement? Do we mean *structural change* (removal of non load bearing segments) in the existing plant after a period of years? . . . during the summer months? . . . during a week's vacation period? . . . over a weekend?

Are we referring to *rapid change of space sizes and configuration by virtue of movable partitions* that can be manipulated by the school maintenance crew overnite? . . . between class periods? . . . or without a crew, either electronically or mechanically at will on a moment's notice?

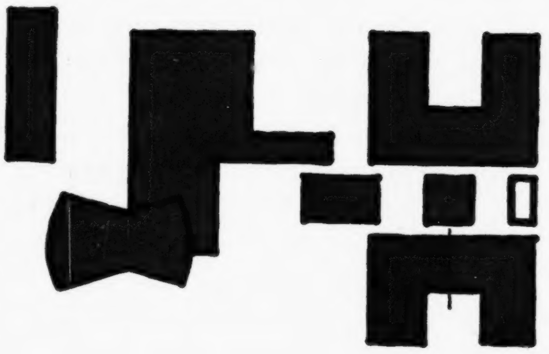
Or do we mean *immediate flexibility achieved simply by the installation of furniture and furnishings that can be moved or removed*, stacked, nested, rearranged and grouped in a variety of combinations of space-within-space?

These definitions of the term imply physical change after the school has been built. Even more important than any one of these is the *flexibility built into the specifications before the fact, detailing the need for a variety of spaces specifically designed and oriented within the total school plant to satisfy the needs of group of various sizes and interests.*

flexible School – movable partitions



Hillsdale High School, Calif. Architect: John Lyon Reid

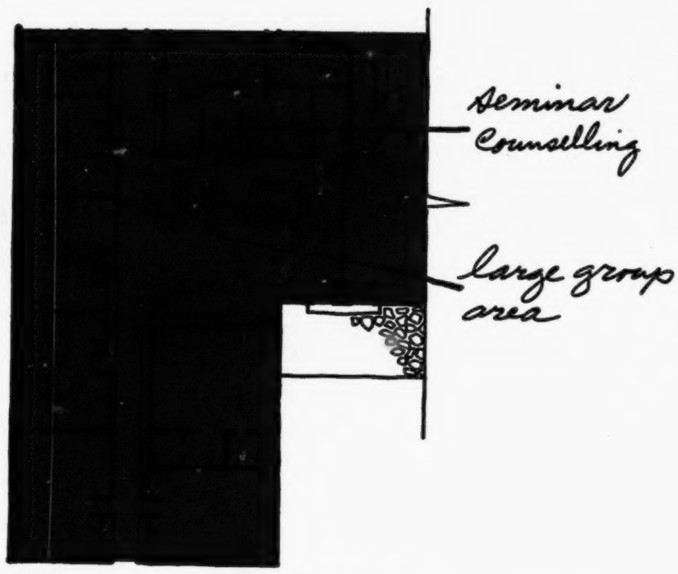


Where are the individual study areas? How many? How about seminar sized rooms and teachers' counselling areas or offices? Are learning spaces for closely related subject areas so grouped that they can use common facilities? Are resources and supplies provided and accessible to student and teacher on immediate call when needed? Is the balance of large, medium and small group spaces proper? Are facilities available when needed, but still efficiently used for a major portion of the time the school plant is open? Are facilities available for use after normal school hours?

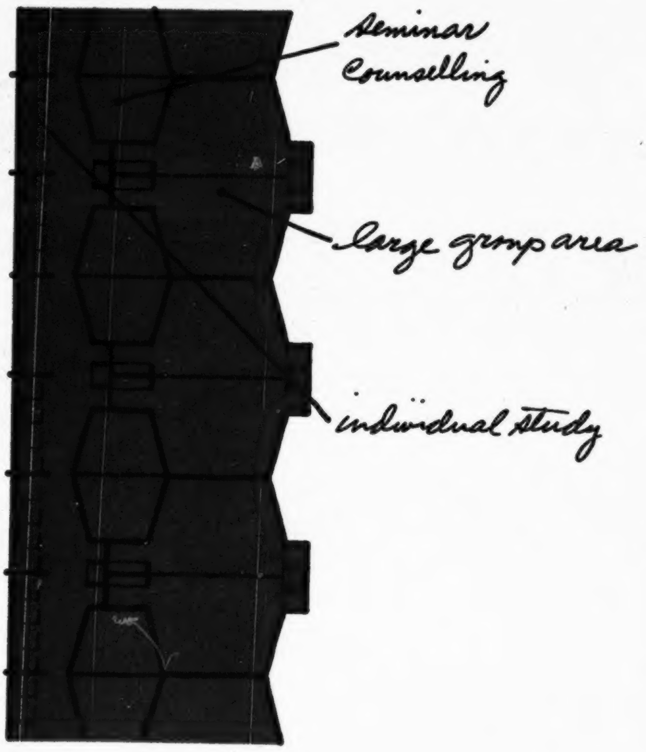
It is obvious that these answers can only come after school planners have determined the most basic patterns of their educational program. The school curriculum, student grouping patterns and teaching techniques, the use of the best tools to support the teaching effort, even general administrative organization directly effect the design of the entire school unit and its parts.

Where creative administrators have supplied these details to equally creative architects, the combined effort of the two has paid off handsomely. Spotted around the country are schools that are leading the way in successfully supporting the teaching-learning process. These are not necessarily high-cost schools, though it is important to remember that you get no more than you pay for in the space and quality of materials used in any structure.

The greatest economy any planning group can anticipate is the economy that comes from the efficient use of space and facilities. Before insisting on an auditorium in the school as a matter of community pride, planners should first ask whether the space is really needed for purposes that could not be satisfied better and more economically in other ways. Couldn't all-school meetings, for example, be televised to each

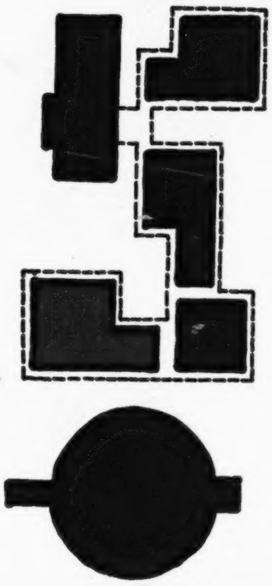


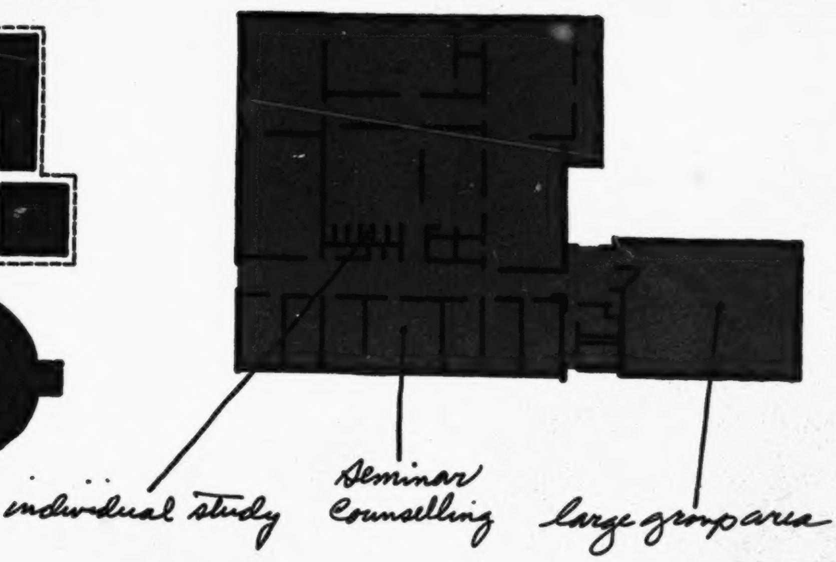
North Hagerstown High School, Maryland
Architects: McLeod & Ferrara



Chicago Teachers College Architect: Perkins & Will

Wayland Senior High School, Wayland, Mass.
Architect: The Arch. Collaborative

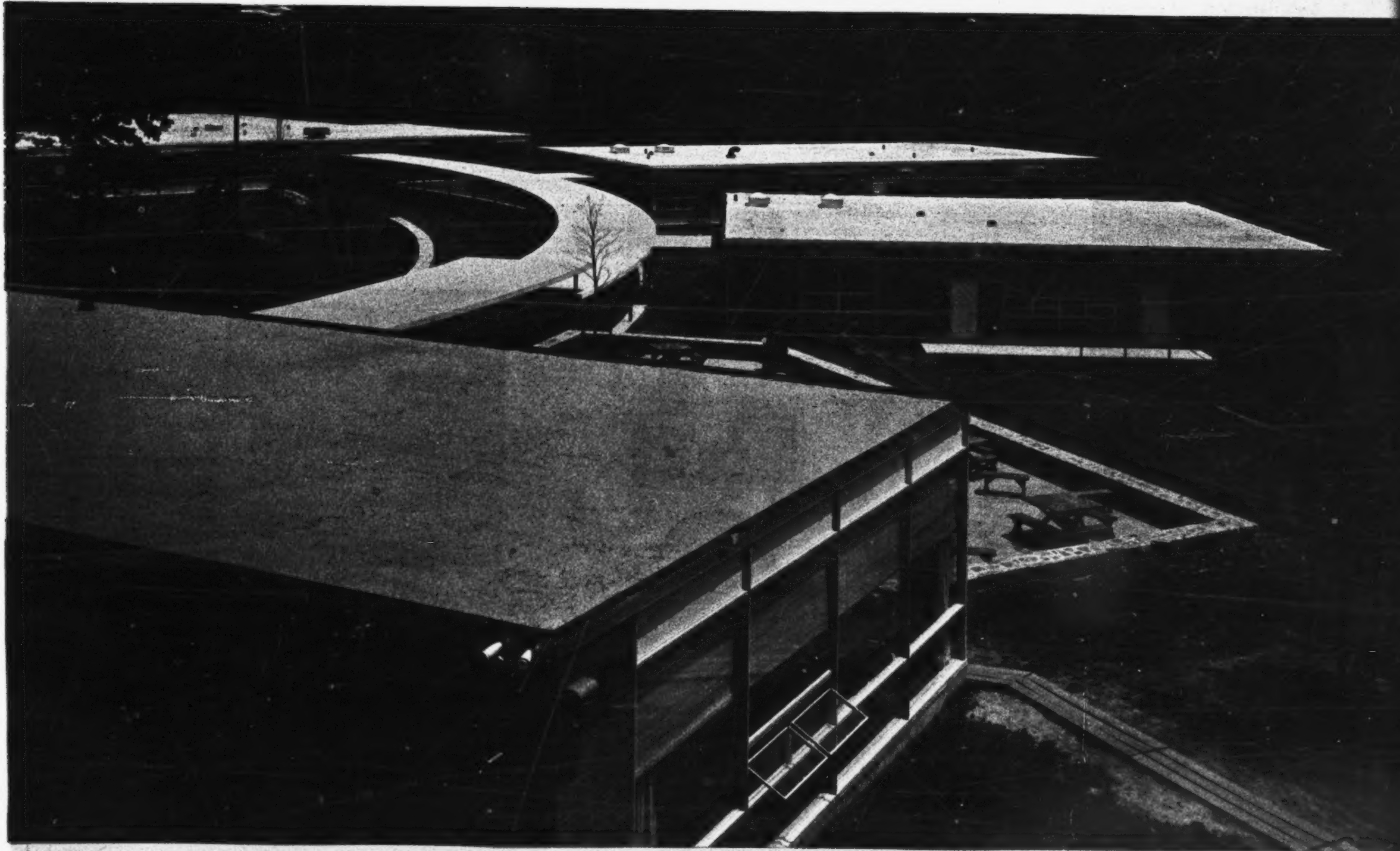


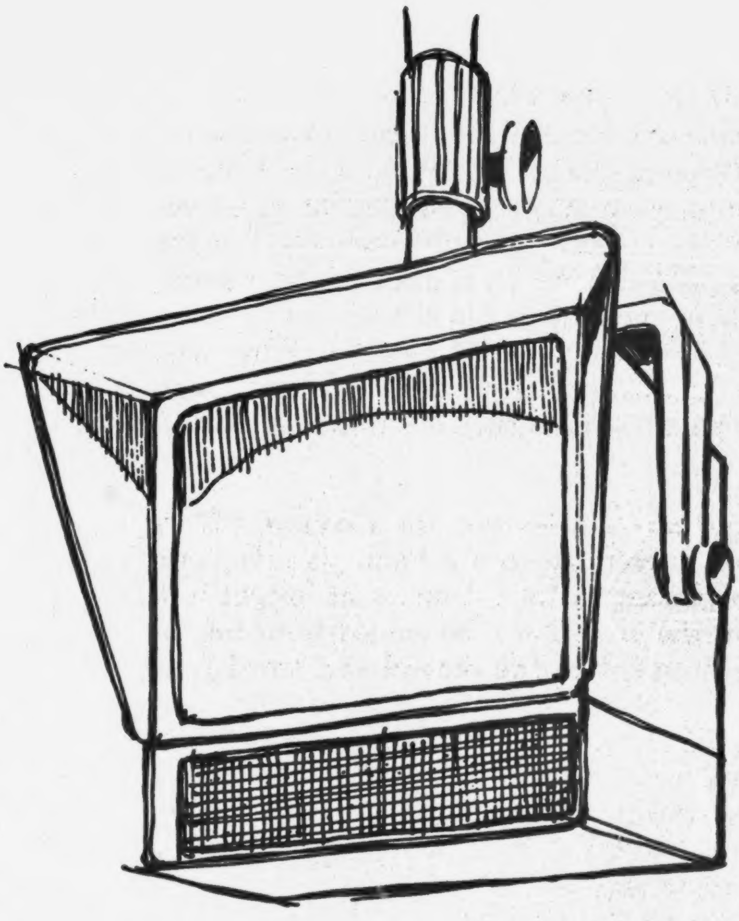


room in the school? Couldn't some community and school meetings be held in the gymnasium or field house? Couldn't the graduation be held outdoors, in rented community facilities or in the field house? Should the library stand half used most of the time . . . or can this natural resource area include spaces for individual study? Wouldn't a little-theater facility also be useful for lectures, demonstrations, possibly a television studio facility and a music room? Could not food service be supplied to several more pleasant, intimate dining areas that could also serve for teaching areas rather than building a barn of a gorge-and-go cafeteria that smacks of the production line?

The ground rules of education in the U.S. are changing dramatically in response to the evident need for change. It is true that a certain amount of flexibility can be built into our architectural plans to meet changes of the future. But we can demand only so much flexibility of the basic building materials. We cannot alter the human ability to hear and see, and must deal logically with acoustical, lighting and ventilation problems.

The larger part of the responsibility for the flexibility in school design, therefore, sits with the planning of the educational program. A creative plan in programming must precede creative design of the school facility.





Television in education has a significant if short history. It has already become a part of the teaching program in schools and colleges across the United States.

After a few scattered starts in 1953-54, the television experiments began to spread. The Pittsburgh school system was one of the first to broadcast televised programs to assist teachers in their regular classrooms—reading, arithmetic and French at fifth-grade level as a beginning. Before long the first station was not adequate to fulfill the needs. A second station was added in 1957 and a third is being planned. Television for direct teaching, general educational use and enrichment *is working in Pittsburgh because those involved wanted to make it work,* not only for elementary and secondary levels, but also for adult education.

Perhaps the best known of the closed circuit school television projects was started in September, 1956, in Hagerstown, Maryland. In the first year some 5,300 students were receiving one lesson each day by television. By 1957 there were 12,000 students sharing the television broadcasts. By 1959 the 5-year "experiment" had spread through the entire Washington County school system to reach 16,500 of the 18,000 pupils enrolled in 37 of the county's 49 public schools. For the '59-60 session plans called for inclusion of the remaining 12 schools in the system along with the Hagerstown Public Library and the Museum of Fine Arts. An entire range of subjects for grades one through twelve in the public schools emanate from five central studios.

The first major use of television for a college educational program is credited to the Pennsylvania State University, beginning in 1954. Important insight into the purpose of the project can be gained from the introductory statement to the second and third year report: *". . . The central theme . . . is not television in higher education; the central theme is the improvement of both teaching and learning, especially the learning and academic achievements of students. Teaching by whatever methods, and the use of television, however employed, are only means and not goals."*

Adult education? Chicago City Junior College has been broadcasting a home television education program since September 1956. Estimated audience—30,000 to 50,000 students per viewing. Average age of home listener—35 years. In this audience—over six semesters—there were almost 30,000 registrations for the course, 7,572 of these on a for-credit basis. Quality results? "We have learned that home viewers who enroll for credit courses perform as well or better than on-campus students . . . did noticeably better than the campus students on common examinations."

Continental Classroom—the coast-to-coast network television teaching program—is now reaching an estimated 414,000 viewers for a 6:30 a.m. course in "Modern Chemistry". A half hour earlier, 66,000 persons watch the re-run of "Atomic Age Physics" which last year attracted 400,000 viewers.

And so the background of experimentation and experience has built from these beginnings to the record at the beginning of 1960—*569 school districts across the nation making regular use of televised instruction: 117 colleges and universities offering credit for television courses; 144 closed circuit television systems in educational institutions and another 21 for the military; and 45 educational television (non-commercial) stations in operation.*

Why has television proved so effective when other projection and filming techniques have had only lukewarm reception in the past? Of audio-visual tools available, television appears to offer the broadest potential. The teaching image is easily transmissible by air and cable. It is reproducible from magnetic tape. It is viewable at relatively high ambient light levels without the need for darkening a room. It permits viewing of current events concurrently with the occasion. Taped programs, entire courses or laboratory demonstrations may be banked in libraries for use as required. Such tapes and/or programs for the slow learner or the advanced student may serve to enrich the gifted and help the slow. The viewing and audio instrument itself is relatively inexpensive, easily used, widely available and easily maintained. The arts of the industry are rapidly improving receiving, transmission, recording and production equipment.

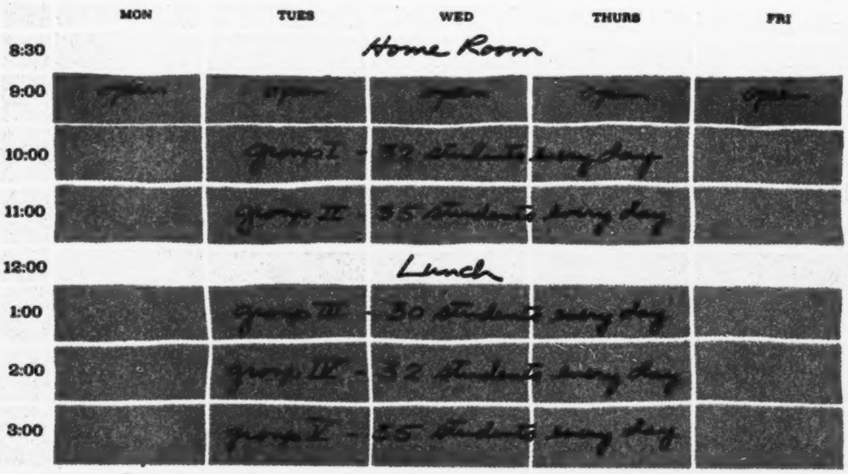
Some of the liabilities of television (as compared to other audio-visual aids) are in the process of being rectified. Full color, for instance, which can be extremely useful, is still comparatively expensive and will probably not be available for some time at costs which make its use in schools feasible. On the other hand, video tape recording equipment, which now runs in the neighborhood of $50,000 for a single professional unit, will reportedly be available within two to three years in models suitable for school need in the $10,000 price range. *The introduction of a video tape unit at this price could make complete control of originating facilities financially feasible for even a moderate sized school.*

Undoubtedly the major misconception concerning the use of television as an educational aid is that television will or can replace the teacher. The problem in reality is that we don't have enough expert teachers to do the job that must be done, with or without television. *A machine alone cannot (and is not expected to) counsel, assist, direct, inspire and at times salve the hurt feelings of the student. The personal presence of responsive teachers will still be needed in the school. Televised programming will require even more first-rate teachers than we now have. Nothing comes across with less impact than televised mediocrity. Televised teaching requires greatness.*

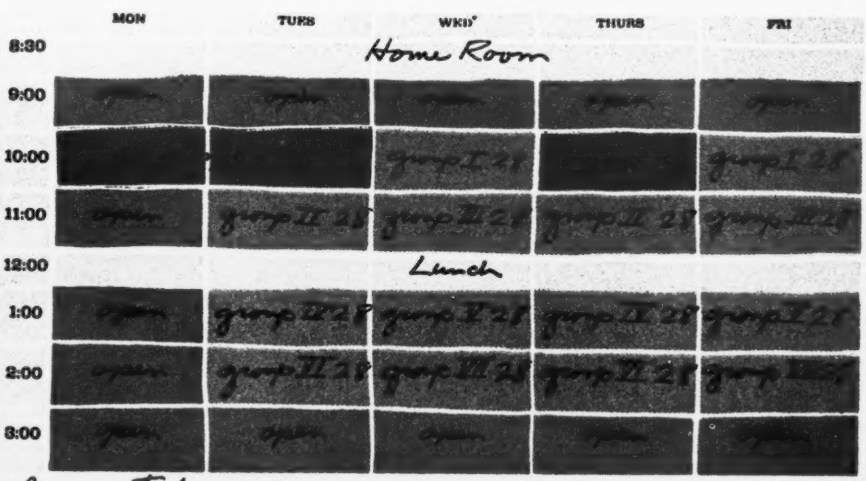
This requirement for "greatness" should not be misconstrued to mean that a television teacher needs superficial personality, charm or camera appeal. The studio teacher's knowledge of the subject, ability to communicate, creative presentation of ideas, use of visual aids are all offered for close scrutiny to an audience of hundreds—even thousands at one moment. It is not enough to simply pick up conventional classroom teaching techniques and put them before a camera. New procedures will evolve as educators use the new medium at their disposal to full advantage.

Changes will also have to come at the receiving end of the televised educational program. How we group

NEEDED: TIME for more effective teaching



traditional:
1 teacher - 5 hours open - 25 class sessions - 164 students



Suggested:
1 teacher - 13 hours open - 17 class sessions - 196 students

Redeployment of teachers and students for a break from traditional schedules could allow for better teaching and more effective use of the teacher's skills and time. Large groups meet for instruction, smaller groups for more direct teaching. Gain in this sample—8 additional free periods for individual counsel and class preparation as well as more teaching in smaller groups of 28 students.

and schedule students in the school and how we measure their degree of advancement require re-evaluation.

Conventional testing procedures, for example, will not reveal the gain in teaching-learning impact when a student learns about practices in the U.S. Senate by watching a televised interview with the senator of his own state answering questions put to him by a teacher of American History, Civics or Current Affairs. The student in this case has been exposed to more than the basic facts about the Senate and the Senator. If this very real plus value is to be measured, last year's test forms will have to be revised.

One of the major purposes of this design study as outlined by EFL was to determine to what extent the use of television affected the facilities, size, shape and structure of the learning area. Our conclusion is that the tail does not wag the dog as might have been expected. Structural allowances must be made for proper installation of conduit or raceway to carry the cables for closed circuit transmission. Studios or classroom facilities used for origination of a program require special wiring, lighting and ventilation. Beyond these considerations, no special architectural allowances are imposed for television reception in the school.

If the designs for learning areas shown in section six of this report look different than your current classroom, it is likely your current facilities are not all they could be, with or without television.

Televised programming in the school is generally broken into two areas of purpose—(1) instructional programs and (2) general educational programs for enrichment, etc. By general definition, instructional programs (ITV) are those planned and implemented by a teacher or group of teachers (or group of schools) to fulfill a specific lesson plan for a particular subject in the curriculum. General educational programs (ETV) might include instructional programs, but also encompass the limitless range of general information broadcasts with educational value.

Immediate reports of current news events as they happen; field trips to any location in the country or the world; detailed laboratory experiments for the school without laboratory facilities—these are just a few of the possible educational uses of television, with immediacy a distinct plus. Stored on video tape, such programs could be on tap for use by any teacher at will.

A school television system installed for educational purposes can also be used for administrative functions to relieve administrators and faculty of tasks that normally divert their attention from the teaching job itself. These advantages accrue to the school without appreciable cost changes once the system is built in. Communication between the teachers and staff leaders or from the main office to all students; teacher training; direction of fire and safety drills; monitoring of cafeterias, group meetings, corridors—an educator can expand this list considerably.

When do you start in planning your school with television? The following pages offer a guide. Since the origination, transmission and reception equipment are the prime necessities, they are discussed first. Following are some of the individual elements of furnishings and furniture for the various spaces within the school. In section six, all are put together for a total school space concept.

ORIGINATION, TRANSMISSION,

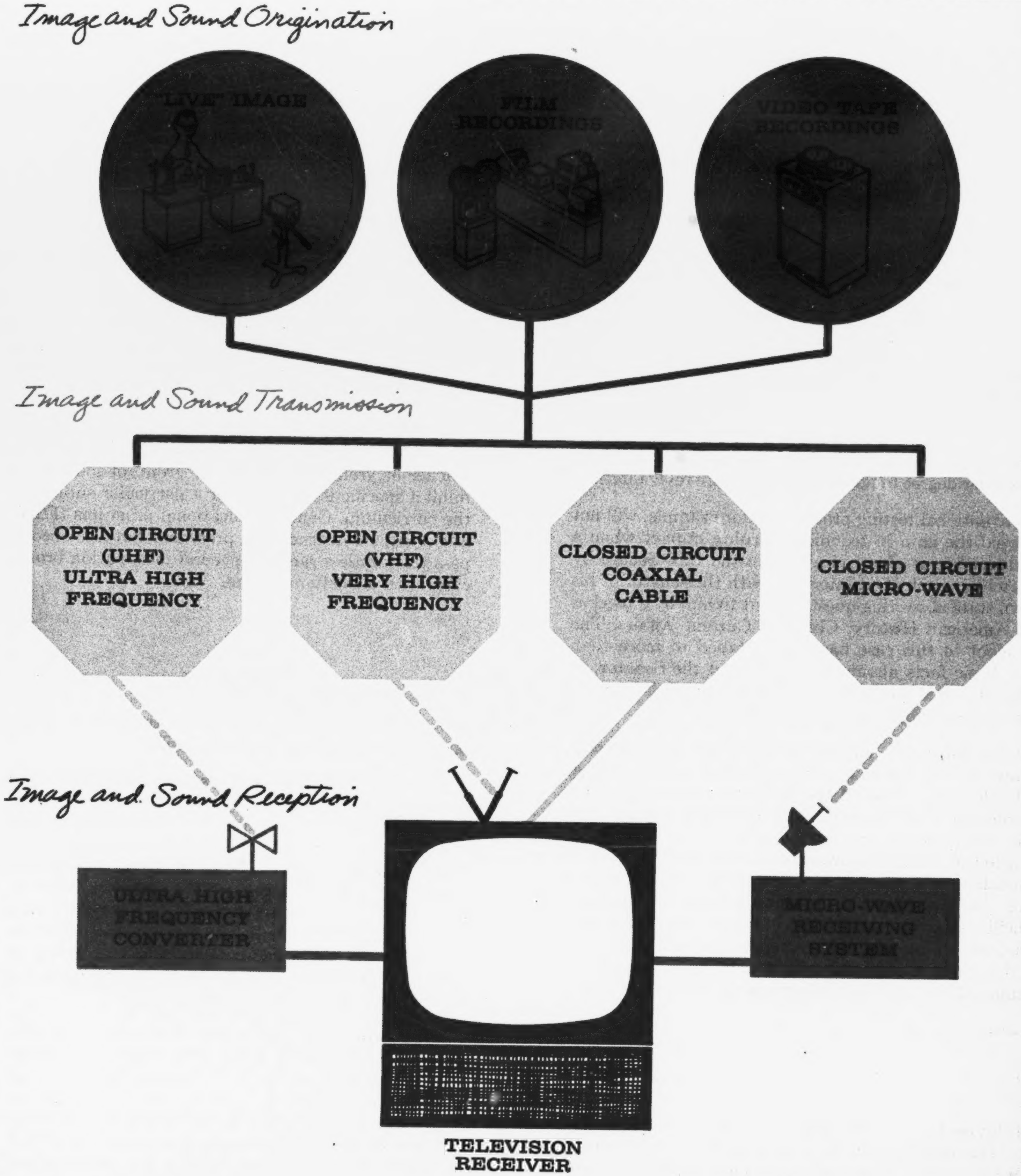


Image and Sound Origination
"LIVE" IMAGE
FILM RECORDINGS
VIDEO TAPE RECORDINGS
Image and Sound Transmission
OPEN CIRCUIT (UHF) ULTRA HIGH FREQUENCY
OPEN CIRCUIT (VHF) VERY HIGH FREQUENCY
CLOSED CIRCUIT COAXIAL CABLE
CLOSED CIRCUIT MICRO-WAVE
Image and Sound Reception
ULTRA HIGH FREQUENCY CONVERTER
MICRO-WAVE RECEIVING SYSTEM
TELEVISION RECEIVER

RECEPTION

"LIVE" IMAGE

The telecasting of actual events, programs, lessons, etc.

1. Has "timeliness." Actual events, programs are telecast and viewed almost simultaneously.
2. Excellent for presentation of extemporaneous-type performance and demonstrations; spontaneity of live instruction can add "human" contact with student.
3. Networks possible for wide distribution.
4. Future potential—color.
5. Least flexible in terms of time, performance and scheduling. Telecast must be viewed at time of performance unless recorded. Errors in performance are not easily corrected.
6. Control of lighting, acoustics, etc. necessary at point of origination at telecast time.

FILM RECORDINGS

The telecasting of events, programs, etc., recorded on film, slides, etc.

1. Events and programs can be preserved for future use. They can be telecast at any time in schedule or repeated.
2. Performances can be edited and the quality and content of finished product controlled.
3. Outside world events easily brought into classroom.
4. Large monochrome and color film library exists—some require clearance and/or royalties for television. Films can be made in multiple copies and distributed for ETV.
5. Films usually involve considerable expense and time to produce, process, edit and print.
6. Can become dated.

VIDEO TAPE RECORDINGS

The telecasting of events, programs, etc., electronically recorded on magnetic tape.

1. Allows scheduling to meet the teaching need. Can be telecast at any time and offers repetitive instruction. No time required for processing, it is ready for immediate use after recording. Video tape can be edited, erased, reused and duplicated for exchange use between schools.
2. Mobile tape recorder—near future possibility. Will be used in classroom, studio, or on location. Outside world events can be brought into the classroom.
3. Future TV tape telecast presentation in color.
4. Can become dated.
5. Current equipment restrictively expensive.

OPEN CIRCUIT (UHF) ULTRA HIGH FREQUENCY

Regulated by Federal Communications Commission (FCC).

1. Transmission is generally omnidirectional; reception is multipoint.
2. FCC allocated range for commercial and educational use:
   470-890 megacycles at 6 megacycle bandwidth channels. 70 channels #14-#83.
3. The station location, area served by the transmitter, etc. are governed by physical and geographical conditions, and FCC.
4. Application must be filed with FCC for broadcast within this frequency range.

OPEN CIRCUIT (VHF) VERY HIGH FREQUENCY

Regulated by FCC.

1. Transmission is generally omnidirectional; reception is multipoint.
2. FCC allocated range for commercial and educational use:
   54-88 megacycles at 6 megacycle bandwidth channels. 5 channels #2-#6.
   174-216 megacycles at 6 megacycle bandwidth channels. 7 channels #7-#13.
   Total channels—12.
3. The station location, area served by the transmitter, etc. are governed by physical and geographic conditions, and FCC.
4. Application must be filed with FCC for broadcast within this frequency range.

CLOSED CIRCUIT COAXIAL CABLE

Not controlled by FCC so long as spurious electromagnetic radiations are suppressed.

1. Two types of signals are transmitted by coaxial cable:
   The "video" frequency signal (the image signal originating at camera chain or video tape recorder). Only one signal can be transmitted through one coaxial cable at one time.
   The VHF radio frequency (RF) signal, (the video and audio signal modulated VHF RF carrier wave). Several signals can be transmitted simultaneously through one coaxial cable.
2. Number and location of modulators, amplifiers, etc. will depend on the installation.
3. Transmission distance limited by cost factor.
4. Modulated VHF signals can be transmitted over greater distances than video signals.

CLOSED CIRCUIT MICROWAVE (ULTRA HIGH AND SUPER HIGH FREQUENCIES)

Regulated by FCC.

1. Transmission is unidirectional. Reception is effected at one point only. This is often referred to as "point to point" transmission.
2. The FCC allocated frequency range for educational use:
   At present none available for educational closed circuit television use. Some available for open circuit broadcast relay.
3. Transmitter location (mobile or fixed), transmission distance, etc., are dependent on physical conditions in area to be used as well as FCC ruling.
4. Application must be filed with FCC for relay services of this type.

IMAGE AND SOUND RECEPTION (UHF)

Receiving antenna designed for UHF frequencies. A VHF receiver equipped with UHF tuning circuits is used for open circuit reception.

For closed circuit television (CCTV) systems, RF UHF signals received on master antenna array are converted to RF VHF signals at "Master TV Control" and distributed to receivers. A VHF receiver is then used.

The UHF signal may also be demodulated at "Master TV Control" into a video signal. A video monitor or a VHF receiver equipped for video input is required. A separate coaxial line is necessary for each video signal and audio cable is needed to deliver the audio signal to the amplifiers and speakers.

IMAGE AND SOUND RECEPTION (VHF)

Receiving antenna designed for VHF frequencies. A VHF receiver is used for open circuit reception.

The same type of receiver is used if reception is effected at a master receiving antenna array and distributed by CCTV coaxial cable by RF VHF signals.

The RF VHF signal may be demodulated at "Master TV Control" and the video signal distributed with a video monitor or a VHF receiver equipped for video input. A separate coaxial cable is necessary for each video signal and audio cable is needed to deliver the audio signal to the amplifiers and speakers.

IMAGE AND SOUND RECEPTION (COAXIAL CABLE)

Signals are fed to receiver directly from main coaxial cable to receive RF VHF or video frequency signals.

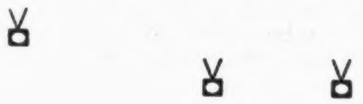
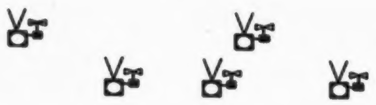
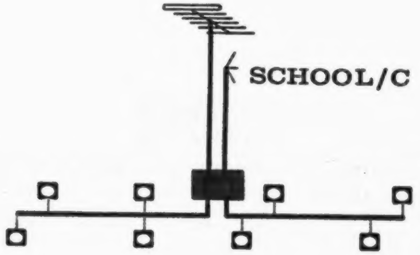
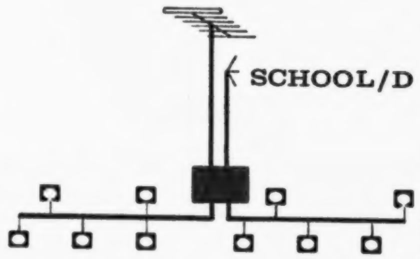
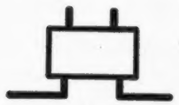
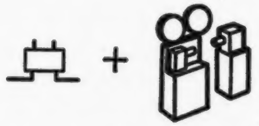
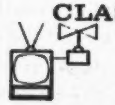
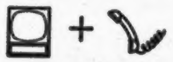
1. A VHF receiver is used for RF VHF signals.
2. A video monitor or a VHF receiver equipped for video input circuits is required for video frequency signals.

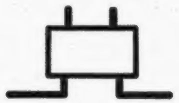
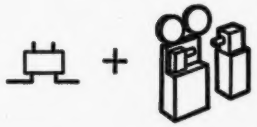
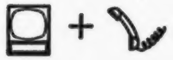
IMAGE AND SOUND RECEPTION (MICROWAVE)

A Microwave system (unit) is comprised of two elements, a transmitter and receiver. These are specially designed to operate as companion units. The receiver demodulates the RF signal from the transmitter into a video signal. This video signal may be distributed in a closed circuit coaxial cable system in two ways:

1. As the video signal—received with video monitors or VHF receivers equipped for video input. Audio cable is needed to deliver the audio signal to the amplifiers and speakers.
2. As RF VHF signal. The video and audio signals from the microwave receiver are used to modulate a VHF transmitter. VHF receivers are then used.

Developing an Educational TV System for Your Particular Needs

IN THE SCHOOL PLANT/A  VHF antenna at each receiver	**SCHOOL/B**  UHF converters. UHF and VHF antenna at each receiver (Receivers with UHF tuners do not need converters)	**SCHOOL/C**  High gain master antenna array for open circuit UHF and VHF	**SCHOOL/D**  High gain master antenna array for open circuit UHF and VHF
STUDIO FACILITIES/A None	**STUDIO/B** None	**STUDIO/C**  "Master TV Control" UHF conversion to VHF (space required for installation of equipment)	**STUDIO/D**  "Master TV Control" UHF conversion to VHF + Film projector-camera chain (space larger than C for film library, installation of equipment, etc.)
IN THE CLASSROOM/A VHF receiver and speaker with VHF antenna	**CLASSROOM/B**  VHF receiver and speaker with VHF antenna +UHF converter (or tuner) and UHF antenna.	**CLASSROOM/C**  VHF receiver and speaker Intercom system to "Master TV Control" and administrative offices	**CLASSROOM/D** VHF receiver and speaker Intercom system to "Master TV Control" and administrative offices
TYPES OF PROGRAM SOURCES AVAILABLE AT ONE TIME/A 1 type of program Open circuit VHF	**PROGRAM SOURCES/B** 2 types of programs Open circuit VHF and UHF	**PROGRAM SOURCES/C** 2 types of programs Open circuit VHF and UHF	**PROGRAM SOURCES/D** 3 types of programs Open circuit VHF and UHF +Closed circuit film
PROGRAM POTENTIAL AT RECEIVER/A*	**PROGRAM POTENTIAL/B**	**PROGRAM POTENTIAL/C**	**PROGRAM POTENTIAL/D**

VHF antenna at each receiver	UHF converters. UHF and VHF antenna at each receiver (Receivers with UHF tuners do not need converters)	High gain master antenna array for open circuit UHF and VHF	High gain master antenna array for open circuit UHF and VHF
STUDIO FACILITIES/A	**STUDIO/B**	**STUDIO/C**	**STUDIO/D**
None	None	 "Master TV Control" UHF conversion to VHF (space required for installation of equipment)	 "Master TV Control" UHF conversion to VHF +Film projector-camera chain (space larger than C for film library, installation of equipment, etc.)
IN THE CLASSROOM/A	**CLASSROOM/B**	**CLASSROOM/C**	**CLASSROOM/D**
 VHF receiver and speaker with VHF antenna	 VHF receiver and speaker with VHF antenna +UHF converter (or tuner) and UHF antenna.	 VHF receiver and speaker Intercom system to "Master TV Control" and administrative offices	 VHF receiver and speaker Intercom system to "Master TV Control" and administrative offices
TYPES OF PROGRAM SOURCES AVAILABLE AT ONE TIME/A	**PROGRAM SOURCES/B**	**PROGRAM SOURCES/C**	**PROGRAM SOURCES/D**
1 type of program Open circuit VHF	2 types of programs Open circuit VHF and UHF	2 types of programs Open circuit VHF and UHF	3 types of programs Open circuit VHF and UHF +Closed circuit film
PROGRAM POTENTIAL AT RECEIVER/A*	**PROGRAM POTENTIAL/B**	**PROGRAM POTENTIAL/C**	**PROGRAM POTENTIAL/D**
7 channels—open circuit VHF potential (alternate channel selection)	7 channels—open circuit VHF potential 35 channel—open circuit UHF potential 42 channel—total UHF, VHF potential	7 channels—VHF potential thru coaxial cable	/ **SCHOOLS C,D,E,F,G AND H**

*(Depending on geographical location, the directivity and gain characteristics of receiving antennas as well as other factors, the open circuit potentials of a TV receiver will vary.

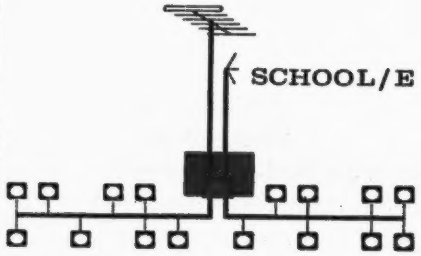
For assured non-interference type reception in a common broadcast area, alternate-channel reception selectivity applies.)

Up to diagram H the programs originating simultaneously have not surpassed in number the 7 alternate channel potential. Also to this point, the potential indicated has been the "natural" frequencies, i.e., the alternate VHF channels 2, 4, 6, 7, 9, 11, 13.

To further increase the program sources, the originating equipment can be duplicated. For example, 2 "live" programs can be added by the addition of 2 more television camera chains. With the program source increase, it is possible also to increase the program potential at the VHF receiver by using the VHF "sub-channel" frequencies (channels below 54 megacycles of 6 bandwidths) or, under certain conditions, the adjacent VHF channels.

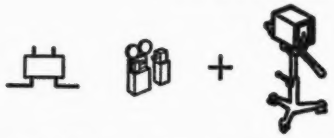
Present day technology is capable of providing a variety of television systems. The following system development chart indicates one basic way in which program selectivity can be increased within the school plant. (The sources originating the telecast, the signal distribution system and the information at the TV receiver are referred to in general terms.)

SCHOOL/E



High gain master antenna array for open circuit UHF and VHF

STUDIO/E



"Master TV Control" UHF conversion to VHF

Film projector-camera chain

+1 television camera chain

Modest studio and control room facilities

CLASSROOM/E

VHF receiver and speaker

Intercom system to "Master TV Control" and administrative offices

PROGRAM SOURCES/E

4 types of programs

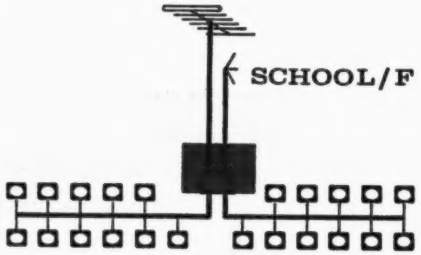
Open circuit VHF and UHF

Closed circuit film

+Closed circuit "live"

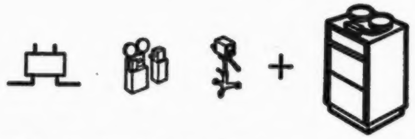
PROGRAM POTENTIAL/E

SCHOOL/F



High gain master antenna array for open circuit UHF and VHF

STUDIO/F



"Master TV Control" UHF conversion to VHF

Film projector-camera chain

Television camera chain

+Video tape recorder

CLASSROOM/F

VHF receiver and speaker

Intercom system to "Master TV Control" and administrative offices

PROGRAM SOURCES/F

5 types of programs

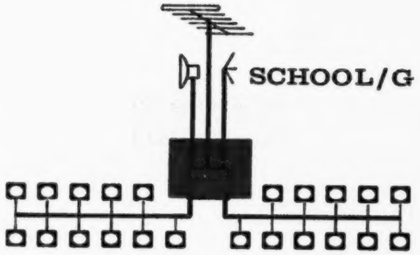
Open circuit VHF and UHF

Closed circuit film and "live"

+Closed circuit video tape

PROGRAM POTENTIAL/F

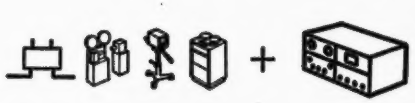
SCHOOL/G



High gain master antenna array for open circuit UHF and VHF

Closed circuit microwave system

STUDIO/G



"Master TV Control" UHF conversion to VHF

Film projector-camera chain

Television camera chain

Video tape recorder

+Closed circuit microwave system

CLASSROOM/G

VHF receiver and speaker

Intercom system to "Master TV Control" and administrative offices

PROGRAM SOURCES/G

6 types of programs

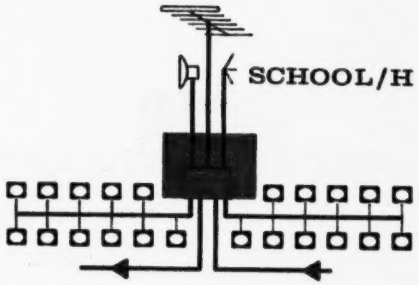
Open circuit VHF and UHF

Closed circuit film, "live" and video-tape

+Closed circuit microwave

PROGRAM POTENTIAL/G

SCHOOL/H

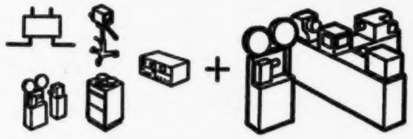


High gain master antenna array for open circuit UHF and VHF

Closed circuit microwave system

- Use of television camera chain or chains in classrooms
- CCTV coaxial cable inter-school "loop" system

STUDIO/H



"Master TV Control" UHF conversion to VHF

Film projector-camera chain

Television camera chain

Video tape recorder

Closed circuit microwave system

+Optical multiplexer and related equipment

CLASSROOM/H

VHF receiver and speaker

Intercom system to "Master TV Control" and administrative offices

PROGRAM SOURCES/H

7 types of programs

Open circuit VHF and UHF

Closed circuit film, "live", video tape, and microwave

+Closed circuit optical multiplexer

PROGRAM POTENTIAL/H

Studio and control equipment space to increase as program originating equipment increases

High gain master antenna array for open circuit UHF and VHF

STUDIO/E

"Master TV Control" UHF conversion to VHF

Film projector-camera chain

+1 television camera chain

Modest studio and control room facilities

CLASSROOM/E

VHF receiver and speaker

Intercom system to "Master TV Control" and administrative offices

PROGRAM SOURCES/E

4 types of programs

Open circuit VHF and UHF

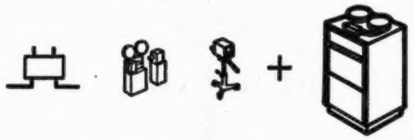
Closed circuit film

+Closed circuit "live"

PROGRAM POTENTIAL/E

High gain master antenna array for open circuit UHF and VHF

STUDIO/F



"Master TV Control" UHF conversion to VHF

Film projector-camera chain

Television camera chain

+Video tape recorder

CLASSROOM/F

VHF receiver and speaker

Intercom system to "Master TV Control" and administrative offices

PROGRAM SOURCES/F

5 types of programs

Open circuit VHF and UHF

Closed circuit film and "live"

+Closed circuit video tape

PROGRAM POTENTIAL/F

High gain master antenna array for open circuit UHF and VHF

Closed circuit microwave system

STUDIO/G

"Master TV Control" UHF conversion to VHF

Film projector-camera chain

Television camera chain
Video tape recorder

+Closed circuit microwave system

CLASSROOM/G

VHF receiver and speaker

Intercom system to "Master TV Control" and administrative offices

PROGRAM SOURCES/G

6 types of programs

Open circuit VHF and UHF

Closed circuit film, "live" and video-tape

+Closed circuit microwave

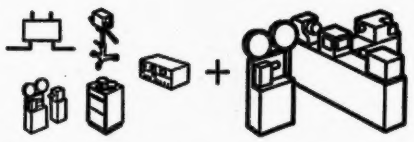
PROGRAM POTENTIAL/G

High gain master antenna array for open circuit UHF and VHF

Closed circuit microwave system

- Use of television camera chain or chains in classrooms
- CCTV coaxial cable inter-school "loop" system

STUDIO/H



"Master TV Control" UHF conversion to VHF

Film projector-camera chain

Television camera chain
Video tape recorder

Closed circuit microwave system

+Optical multiplexer and related equipment

CLASSROOM/H

VHF receiver and speaker

Intercom system to "Master TV Control" and administrative offices

PROGRAM SOURCES/H

7 types of programs

Open circuit VHF and UHF

Closed circuit film, "live", video tape, and microwave

+Closed circuit optical multiplexer

PROGRAM POTENTIAL/H

Studio and control equipment space to increase as program originating equipment increases

1. Antenna isolated from receiver and centralized for better signal reception and control.
2. Coaxial cable installed intra-school to distribute RF VHF channels.
3. Simultaneous transmission of several RF VHF channels possible through one coaxial cable.
4. 35 channel UHF potential transferred to "Master TV Control".
5. Primary program selection at "Master TV Control". Secondary selection at receivers.

It should be noted that broadcast television signal characteristics vary considerably from VHF channel 2 to UHF channel 83. The most favorable conditions occur in the VHF group. Further, the characteristics of VHF "low band" channels 2-6 are more favorable than the "high band" channels 7-13.

Therefore, it is generally desirable to use the VHF "low band" channels and "sub-channel" frequencies for intra-and inter-school CCTV and the VHF "high band" channels more for intra-school CCTV.

In an area where both open circuit VHF broadcasts and closed circuit systems are used, it is desirable that the closed circuit system select channels not used by the open circuit stations. At present, the maximum length of coaxial cable linkage in use between schools is approximately 30 miles from origination point to farthest school.

The "video" frequency signal referred to in the charts has the limitation that only *one "video" signal can be transmitted through one coaxial cable at one time.* An additional pair of lines are always necessary for the *audio signal* transmission. Image resolution from a "video" signal is excellent, as is transmission over a short range of approximately several thousand feet. Due to this range limitation a "video" signal is not applicable for inter-school CCTV.

Where to Start Planning Your ETV System

- I Evaluate your particular needs, whether "enrichment", "supplemental teaching", "direct teaching", etc.
- II Formulate a present and future general plan for use of television (scope of curriculum; group-sizes; origination, transmission, reception methods and scope; etc.).
- III Seek out information on television . . .
  1. by consulting ETV associations: National Association of Educational Broadcasters (NAEB), Joint Council on Educational Television (JCET), Electronic Industries Association (EIA), etc.
  2. by visiting institutions using television.
- IV Use electronic consultants to assist you in developing the originating, distribution, and reception systems and selecting the equipment which will best fill your needs functionally, financially, etc.
- V In planning a new school with television, anticipate expansion needs by working with both electronic consultants and architect *before* plant specifications are set. In adding television to an existing plant, anticipate expansion at the time the original television installation is planned. Installation space, electrical loads, air conditioning, accessibility to conduits, raceways, etc., must all be considered.

These are major considerations

SPACE AND FACILITIES

A. Studio or Image and Sound Originating Space
1. Space required around equipment for operational functions, i.e., traffic, work space, consideration of ceiling height and vertical space for lighting, stage equipment storage.
2. Proper lighting, ventilation and air conditioning are functional requirements.

B. TV Control Space
1. May be space common to all television equipment in modest installation.
2. A special area adjacent to studio space in more complex installation.

C. Offices and Equipment Maintenance Space
1. Necessary for personnel engaged in television production, i.e., technical supervision, project coordination, artists, etc.
2. Television equipment maintenance space should be adjacent to television facilities.
3. These spaces should be closely knit for team function and operation.

D. Library and Storage Space
1. Storage space for "props" and materials used in television adjacent to work area. The space requirements are often underestimated here.

E. Space for Expansion
Do not overlook, because once started, you will undoubtedly expand.
"the more CCTV is used the more economical it becomes."

EQUIPMENT

Equipment can be categorized as follows:

A. Video System
1. *Camera chains, fixed or mobile mounts, single or multiple lens, remote control, switching system, monitoring.
2. Video tape recorder.
3. Opaque, film, slide projection equipment.
4. Control and distribution equipment.

B. Audio System
1. Microphones, control and distribution equipment associated with the image audio.
2. Intercommunications system between television control and reception points.
3. Television control to cameraman and crew.

C. Distribution
Cable system to reception points.

D. Reception Equipment
Monitors, television receivers, frequency converters, etc.

E. Lighting Equipment
Requirements vary with scope of operation from simple to complex spot and flood lighting.

F. Staging
Instructional devices, furniture, draperies, etc.

*For most instructional applications, professional vidicon television cameras are being used. For simple applications industrial type vidicon cameras may be adequate. As of the present most open circuit broadcasters use image orthicon cameras, but some educators are beginning to use professional vidicon cameras for this purpose also.

PERSONNEL

Staff requirements are directly related to the scope of operation. Their functions are:
1. Studio Teaching
2. Project Coordination
3. Technical Supervision and Maintenance
4. Camera Operation and Program Production
5. Art—graphic, photographic and other instructional materials.
6. Secretarial

The number of persons composing the staff may vary; one staff member could conceivably handle several functions, depending on the scope of operation. Students may be part of staff personnel.

COSTS

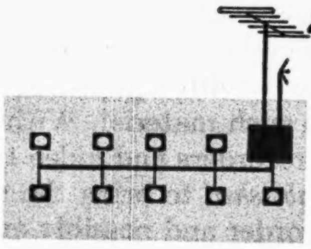
A. Capital Outlay
1. Building and space costs.
2. Equipment and installation.

B. Operational Outlay
1. Salaries and wages.
2. Supplies and materials.
3. Maintenance.

For Example...

Here are a few basic diagrams of ETV systems for
A. Individual schools—small, medium and large
B. Schools linked by CCTV facilities
C. Schools linked by open circuit facilities

The small school equipped with *a master antenna array, television distribution equipment, internal coaxial cable and a number of receivers* has the built-in potential to expand with future needs. Reception quality through the master antenna array and distribution equipment is better than "off the air" reception through individual antennas at each receiver in the school.

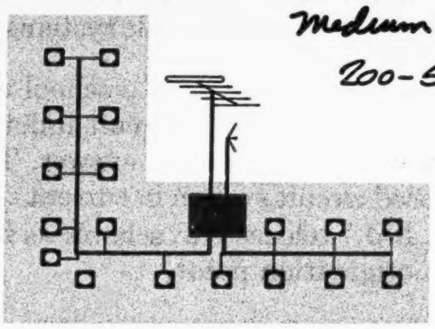

Small School
200 enrollment or less

As shown in the diagram above, the small school can receive programs originated outside the plant as open circuit VHF and/or UHF. For the advantage of greater programming potential, it is most practical that a small school be a part of an inter-school open circuit network system, or linked by a closed circuit cable system. Open circuit broadcasting, with its potential of greater area coverage at comparatively lower costs, may answer the small school's television needs if a closed circuit inter-school system is economically impractical.

Regional and inter-state ETV network plan proposals are currently being considered by three different groups—to make a broad spectrum of subjects and courses available at various grade levels.

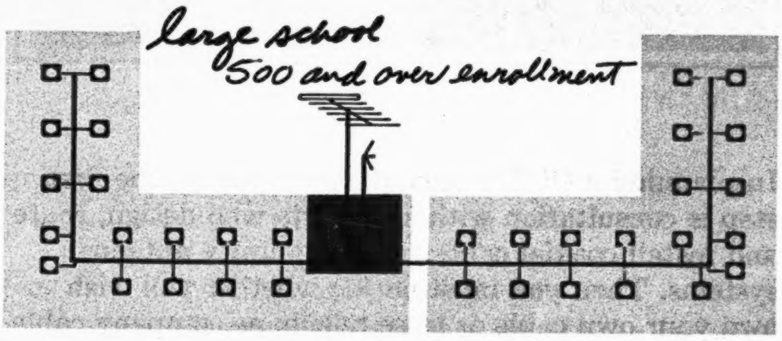
The introduction in the near future of a video tape recorder in a comparatively low price range will allow small schools not only to exchange recorded programs on tape but to cooperatively own and exchange mobile equipment for originating within their own plants as well.

The medium-sized school can realize a greater programming potential on its own than would be economically feasible for the small school. The amount of originating equipment needed is directly proportional to the needs for ETV programming. A larger school enrollment indicates the probability of greater program needs. Consequently, in addition to picking programs "off the air", it could be economically feasible for the school of 200-500 students to install modest studio facilities for intra-school live telecasts.


Medium School
200-500 enrollment

This studio might include such equipment as *a video tape recorder, television camera chain and film camera chain.* A school of this size will also benefit by being a part of an inter-school system, cooperatively exchanging programs and teacher skills by open circuit or CCTV and/or exchange of tapes and films.

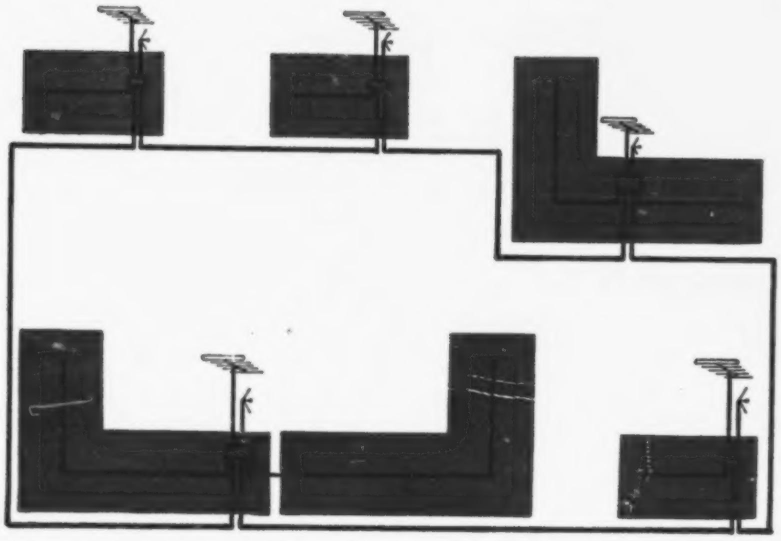
The large school may be self-sufficient in the television sense in that it may be able to afford the economical (full-time) use of *studio space, personnel and equipment* to fill its own requirements. For example, the large school of 500-2000 enrollment could satisfy its programming needs with *a video tape recorder, one or more studio television camera chains, a film camera chain and/or optical multiplexer with television camera chain.* In addition to "off the air" VHF or UHF educational programs, this studio equipment would provide in-plant origination potential of broad scope —"live" programs as well as programs from video tape and telecasting of slides and projected material.


large school
500 and over enrollment

It would be economically practical for the large school to provide the originating center of operations for a network of schools, including in this network smaller plants linked by open circuit or CCTV systems, sharing programs, time schedules and costs.

There are two general approaches to inter-building or inter-school television systems. The primary factor that will dictate the selection of *closed circuit television* or *open circuit television* is the economics of distance. Coaxial cable has its distance limitations costwise. In general, open circuit broadcast has potentially greater service range than closed circuit systems.

For school plants or separate units of a school within a close range of each other, closed circuit linkage by coaxial cable may well be a practical answer. The most extensive closed circuit system in current school use (Hagerstown, Md.) telecasts to schools as far as 30 miles from the origination point.



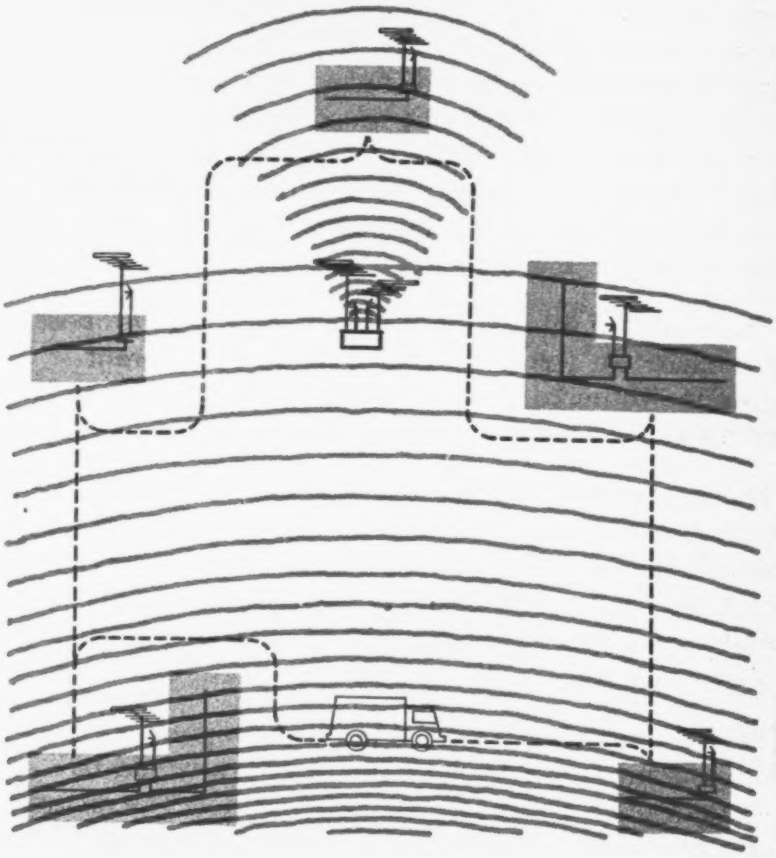
In planning a CCTV coaxial cable system, the first step is consultation with specialists who design, route and install coaxial cable and community antenna systems. Then you must decide whether you wish to own your own cable or lease telephone company cable facilities. Each has its advantages and disadvantages.

The diagram shown above illustrates a *CCTV coaxial cable system linking a group of small, medium and large schools.* Each building is equipped with a master antenna array to allow "off the air" pickup of open circuit VHF and/or UHF educational programs. The cable is "looped" to allow origination of a program at various points within the inter-school system. Without a completed cable "loop", programs could originate only from one centralized source.

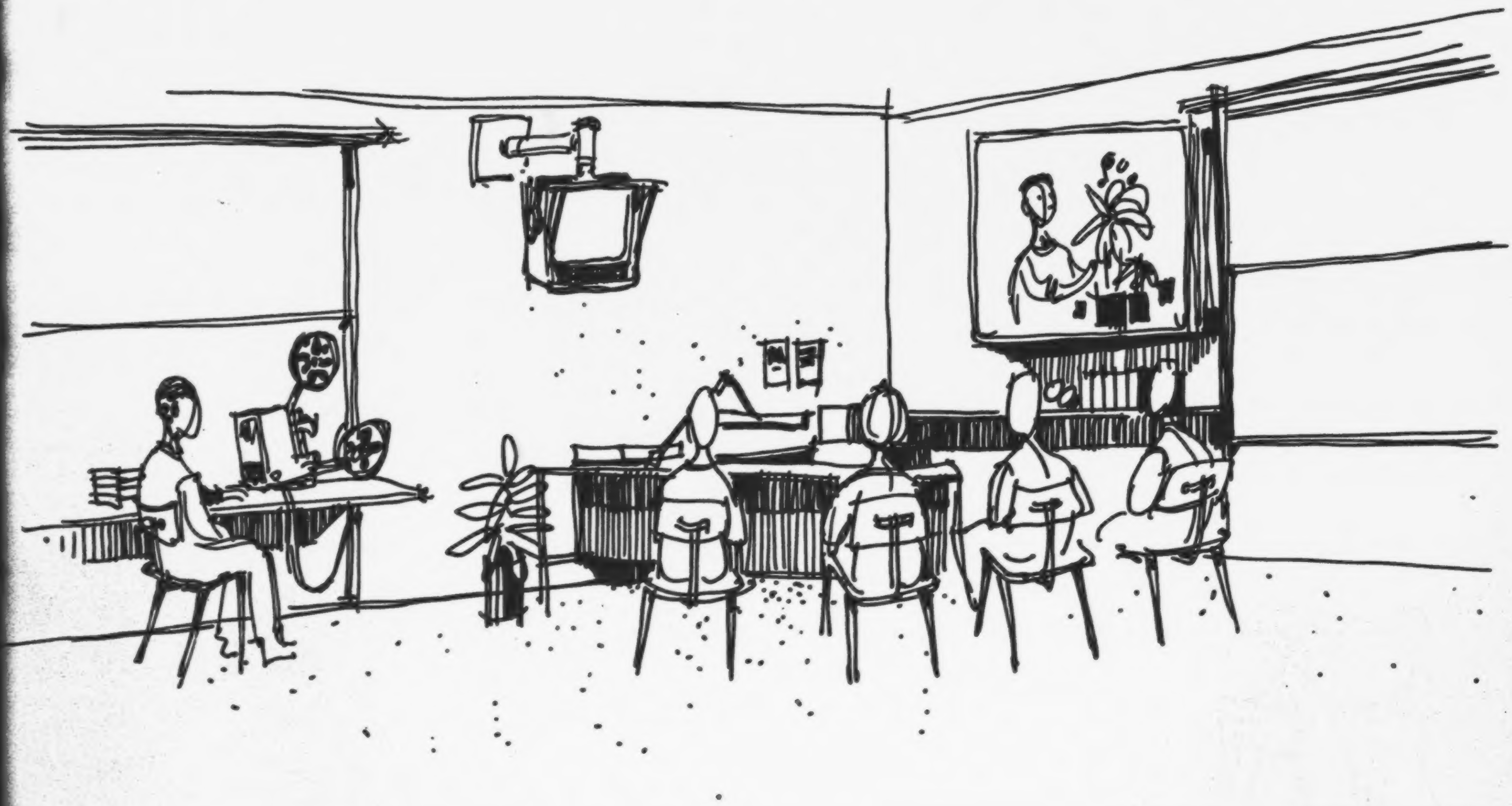
Where the schools are so widely separated by distance as to make a closed circuit coaxial cable linkage uneconomical, communication can be achieved through *open circuit VHF and/or UHF broadcast.* As illustrated in the second diagram below, the VHF/UHF signals can be routed into the individual schools through the master antenna array and distributed through the internal cable system. The same signals can also be received "off the air" directly at the receiver with its individual "rabbit ears" antenna.

The range of the maximum power VHF/UHF broadcast stations can be extended to the schools beyond their range by use of *VHF satellite or UHF translator stations*, by microwave relay or by coaxial cable.

ETV programming within each school can be further augmented by an exchange system of film recordings or video tapes between schools with equipment for originating a program from such material. With the development of video tape recorders and video tapes, *a mobile system could be established* to bring the video tape library, video tape recorder and possibly even a television camera chain to those schools without that equipment. This "mobile television station" could be operated and scheduled cooperatively to meet the needs of several schools in a region or district.



There is no "typical" television system. An installation should be tailored to meet each specific use and condition. It pays to get expert advice from people who have had experience with the kind of operation you plan to use.



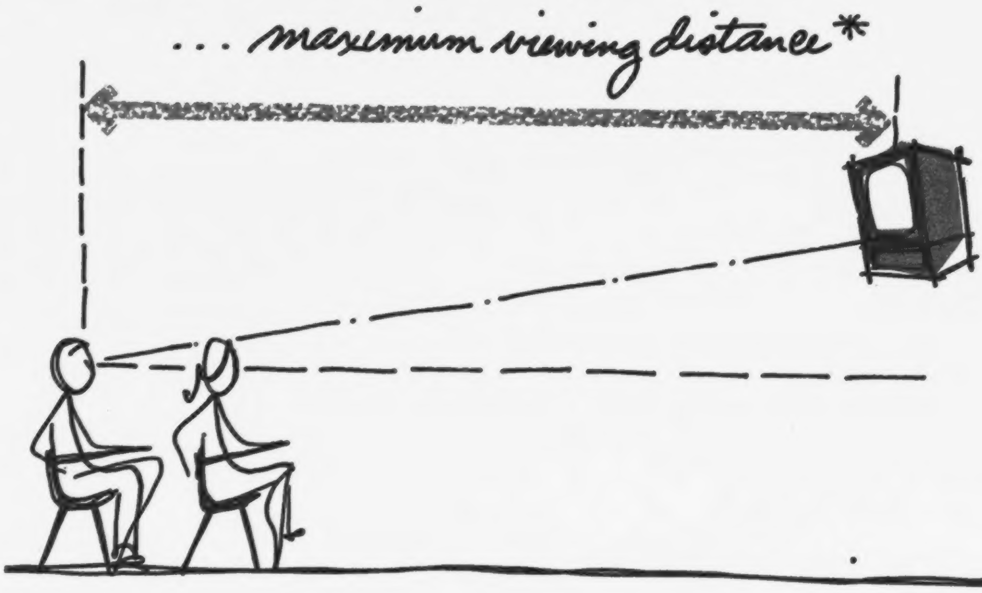
The ability to see, to hear and to react are basic needs for learning. It follows that the physical facilities in the school have a great deal to do with whether a teacher can even begin to reach the students on the most basic levels of communication. Can the student see and hear what is going on? Are lighting, acoustics, ventilation, furnishings proper for the task? Are room colors so depressingly drab that the atmosphere discourages enthusiasm? Facilities can make or break the effectiveness of both the teacher and the learning program.

All of these physical and environmental factors are common problems whether the "teaching image" is in the person of a teacher in the room or is coming to the student via television, tapes, projection or language laboratory equipment. Through the following 15 pages these factors are discussed and diagrammed as they relate to teaching with and without television.

The studies which appear on this and following pages are based on in-line seating arrangements (one student or viewer directly behind the other) because this is the most critical condition in terms of group viewing, i.e., one student must see over the top of the head of the student in front of him. *Staggered seating will allow lower placement of the image than indicated in these charts.*

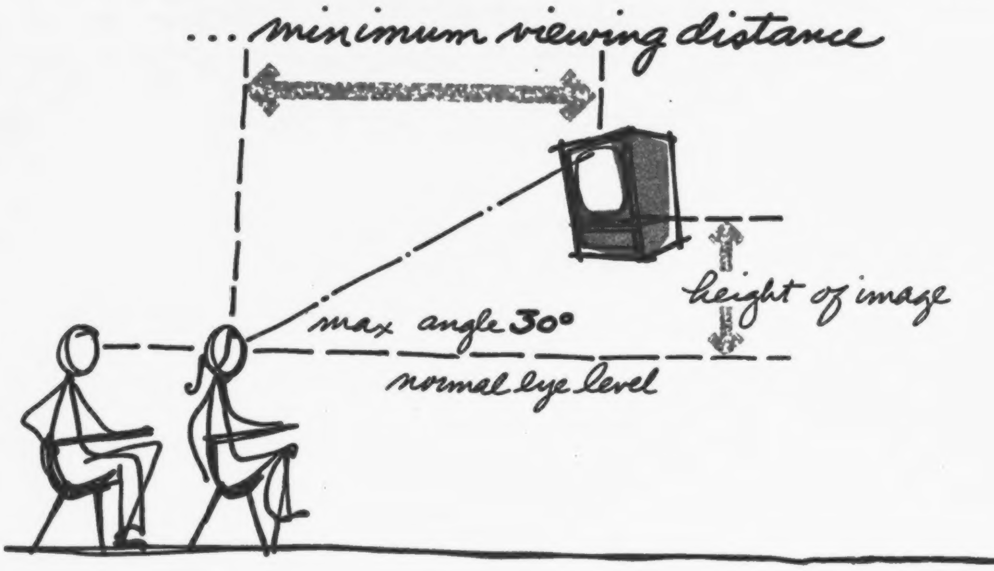
Quality of the televised or projected image is based on optimum quality practical with existing and available equipment, assuming that this equipment is *kept in proper condition* by correct adjustment for use and periodic maintenance checks.

Size of the televised image (screen size) establishes . . .



Size of Television tube	maximum viewing distance
17″	14′-9″
19″	15′-2″
21″	19′-0″
23″	19′-4″
24″	21′-5″

Once the maximum viewing distance has been established, size of the image, unobstructed sight lines from the back to front, and the height of the image placed at the maximum vertical angle for student viewing comfort (30°) must all be considered to establish . . .



minimum viewing distance

Size of Television tube	seat row spacing		
	3′0″	4′4″	5′2″
17″	5′-6″	4′-2″	3′-8″
19″	5′-8″	4′-4″	3′-10″
21″	7′-1″	5′-5″	4′-10″
23″	7′-2″	5′-6″	4′-11″
24″	8′-0″	6′-1″	5′-5″

---

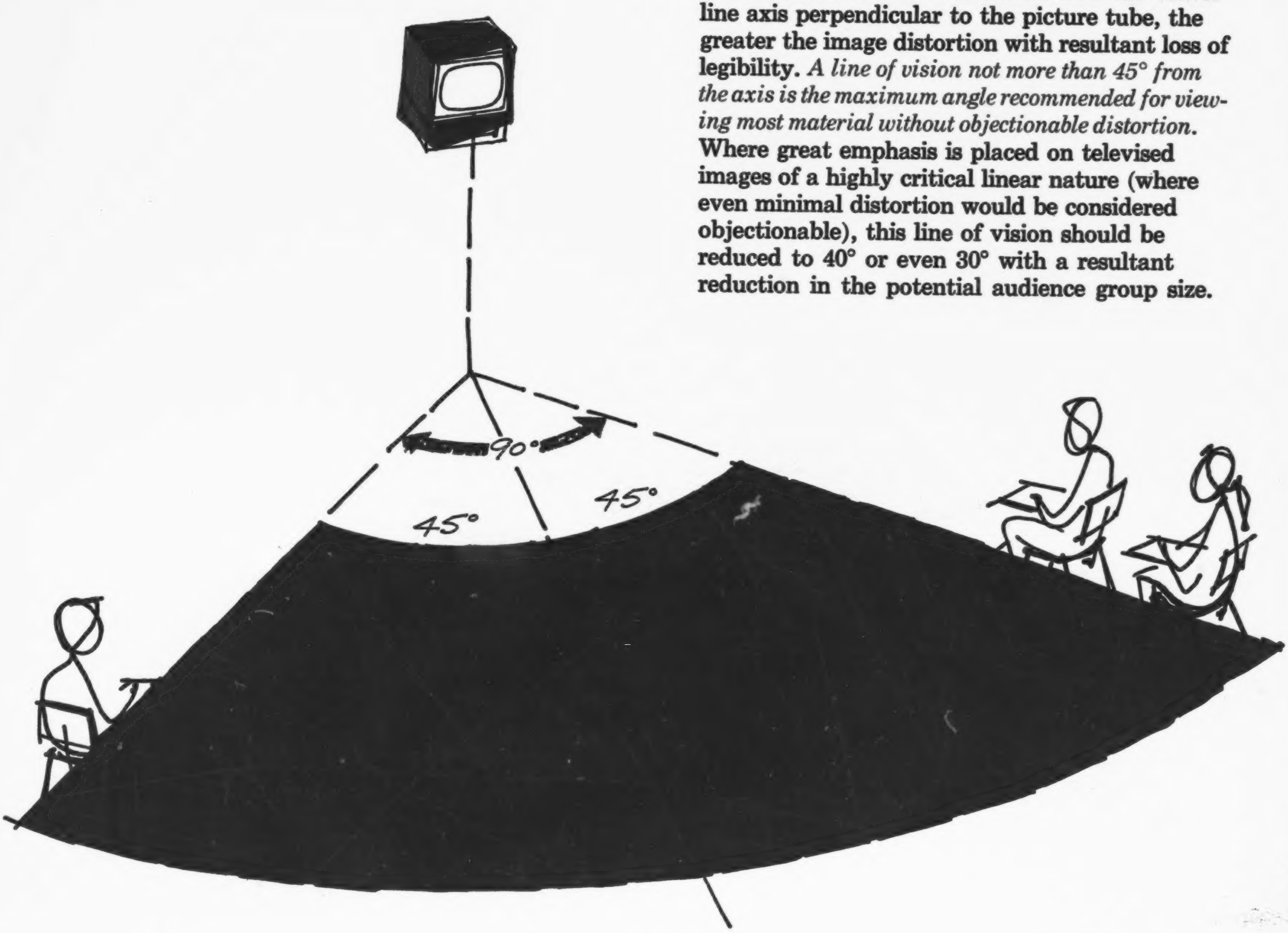
*12 x the actual image width on the picture tube (not to be mistaken for the diagonal measure of the screen generally used to denote size).

Image distortion and legibility must both be considered to determine...

the horizontal viewing angle

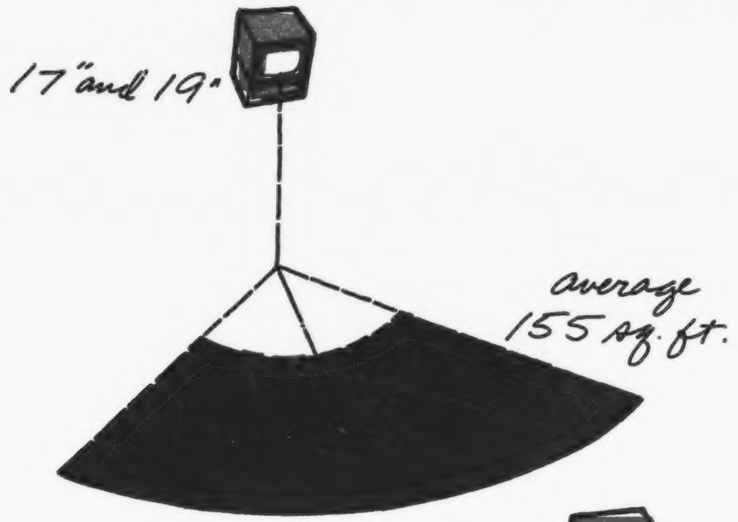
The high brightness characteristic of the television image, the theoretical 525 line resolution and the characteristic curvature of the picture tube all effect the degree of legibility and/or distortion of the television image.

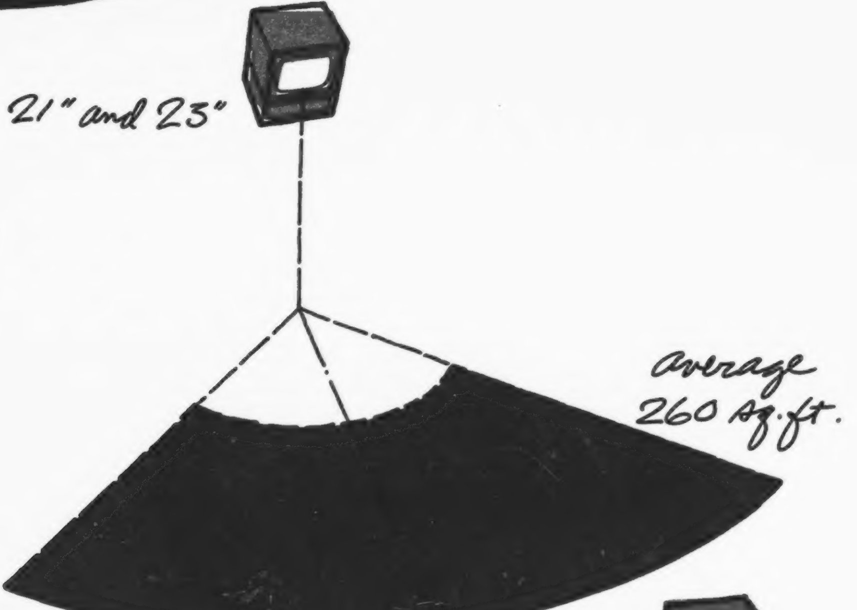
The further the viewer is seated from the center line axis perpendicular to the picture tube, the greater the image distortion with resultant loss of legibility. *A line of vision not more than 45° from the axis is the maximum angle recommended for viewing most material without objectionable distortion.* Where great emphasis is placed on televised images of a highly critical linear nature (where even minimal distortion would be considered objectionable), this line of vision should be reduced to 40° or even 30° with a resultant reduction in the potential audience group size.

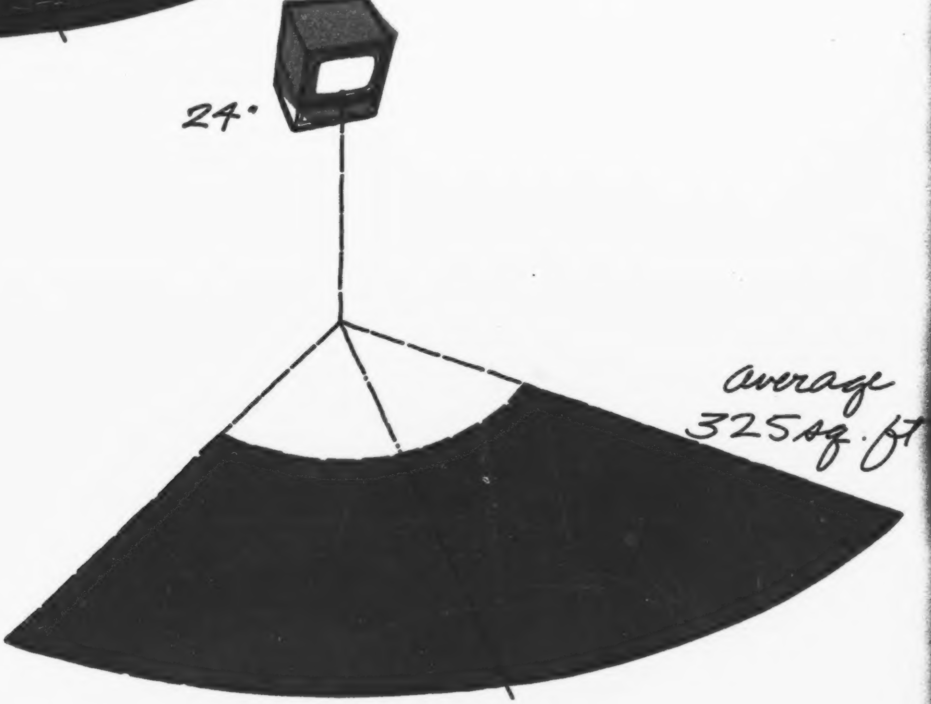


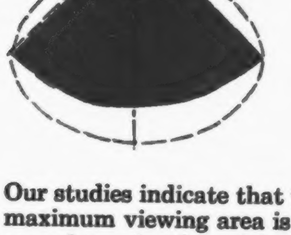
The preceding facts when applied to different size images give the following . . .

Shape and Square footage of viewing areas


17" and 19"
average
155 sq. ft.


21" and 23"
average
260 sq. ft.


24"
average
325 sq. ft



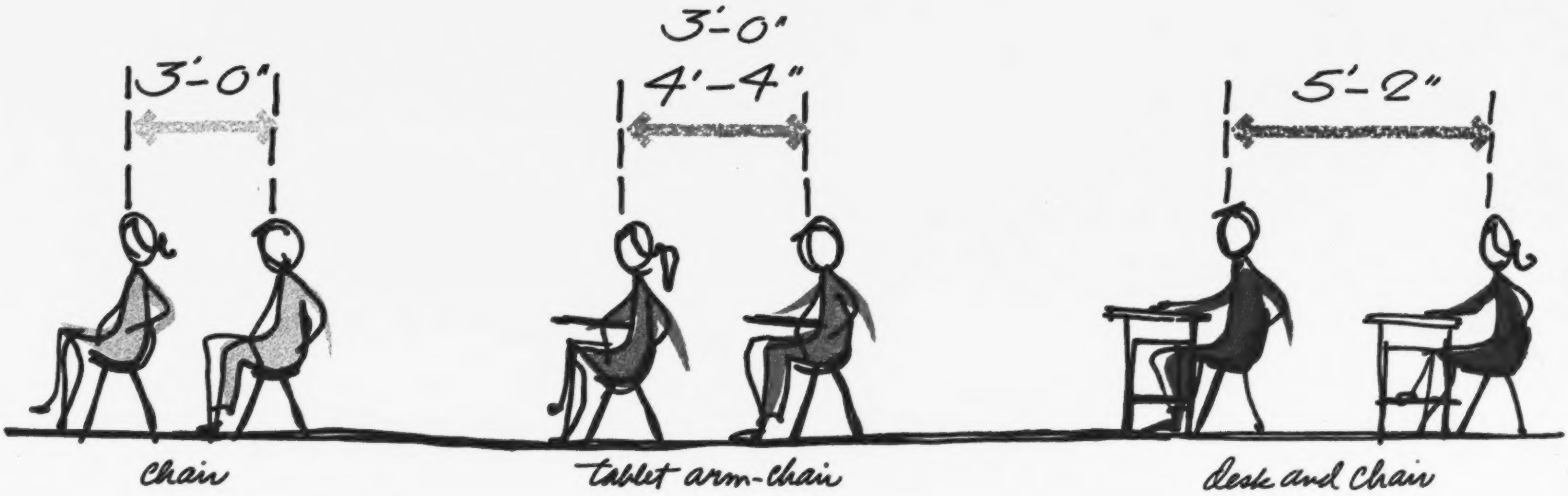
NOTE: Our studies indicate that the actual maximum viewing area is that area shown by the red dotted line.

The areas and distances in this report designated as maximums are optimum areas and distances.

Several factors affect . . .

the number of viewers the various viewing areas will accommodate

1. Type of furniture and spacing
2. Teacher and pupil ingress and egress
3. Educational requirements
4. Building and fire codes



number of viewers*

[illegible]	Chair 3'0" spacing	tablet armchair 3'0" spacing	 4'4" spacing	desk and chair 5'2" spacing
17"	32-34	21	20-23	16-18
19"	36-38	22	20-26	20-21
21"	52-54	31	31-36	24-29
23"	54-56	31	36-38	24-29
24"	64-72	39	41-52	33-34

NOTE: *Refer to page 86 for seat arrangement

The maximum viewing distance and seat spacing establishes . . .

the height of the television image*
(normal eye level to bottom of image)

size of television tube	seat row spacing 3'0"	4'4"	5'2"
17"	26"	17"	14"
19"	27"	18"	15"
21"	34"	22½"	18½"
23"	35"	23"	19"
24"	38½"	25"	21"

To determine the total dimension from floor to bottom of image: Take from the above chart the *eye level to bottom of image* dimension corresponding to the size of receiver and seat row spacing being considered. Add to this dimension the *mean dimension eye level to floor* shown below for the grade required. This sum will give the *total dimension from floor to bottom of image* for that specific application.

The vertical placement of the television image is important for good visibility of the viewing group. As a general rule the closer the seat spacing, the higher the television image. For example for the 23" television receiver the 3'-0" seat spacing requires that the bottom of the television image be 84" from the floor. At 5'2" seat spacing (desk and chair) that height dimension is reduced to 68".

When the vertical dimension of the television receiver is added to these heights, it becomes apparent that the ceiling heights will in some cases be affected. With the housing dimensions and clearance for mounting the receiver included, the minimum ceiling height becomes approximately 9' to 9½' for proper installation and viewing of a 23" receiver and audience in seats spaced at 3'0". If a lower ceiling height is desired, three courses are open—reduce the number of viewers; raise the successive eye level of the in-line rows of seats; or stagger the seating.

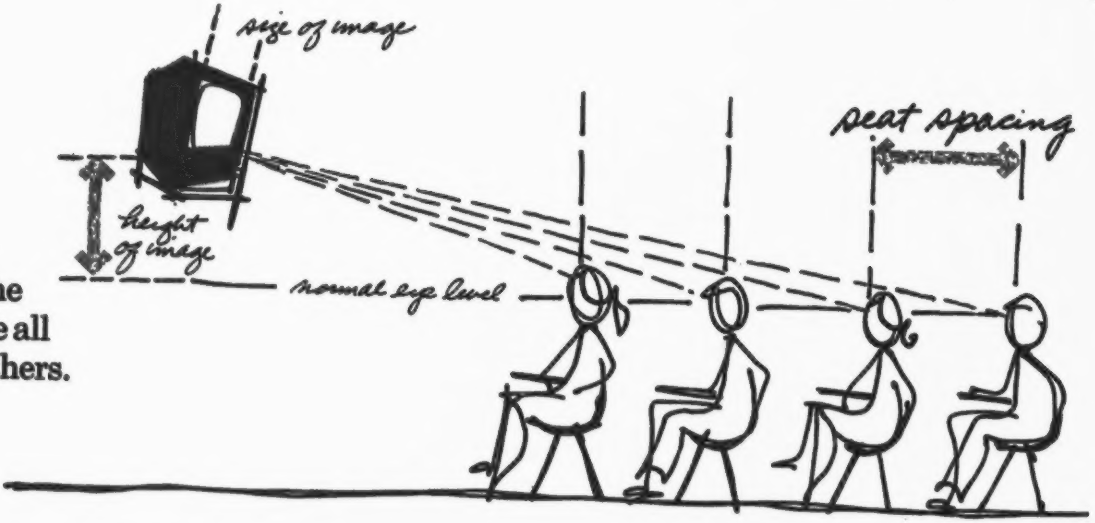
Naturally because of pupil age and size differential, television receiver heights are greater in secondary than in elementary schools. The fact that students vary in height at all grade levels can also be used to advantage if the taller students are placed in the back rows, shorter in front rows in any viewing situation. In some of the newer schools where there has been a trend to lower ceiling heights, vertical placement may become a more serious problem.

grade	K	1	2	3	4	5	6	7	8	9	10	11	12
mean dimension eye level to floor	31"	33"	35"	37"	38"	40"	42"	43½"	44½"	46"	47"	48"	49"
total dimension floor to bottom of image **	66"	68"	70"	72"	73"	75"	77"	78½"	79½"	81"	82"	83"	84"

*Based on a mean dimension of 4½" eye level to crown of head measurement

**Based on 23" television receiver with seat row spacing at 3'-0"

The sight lines, size of the image, height of the image, spacing and location of viewer seating are all interrelated and change in any one affects all others.



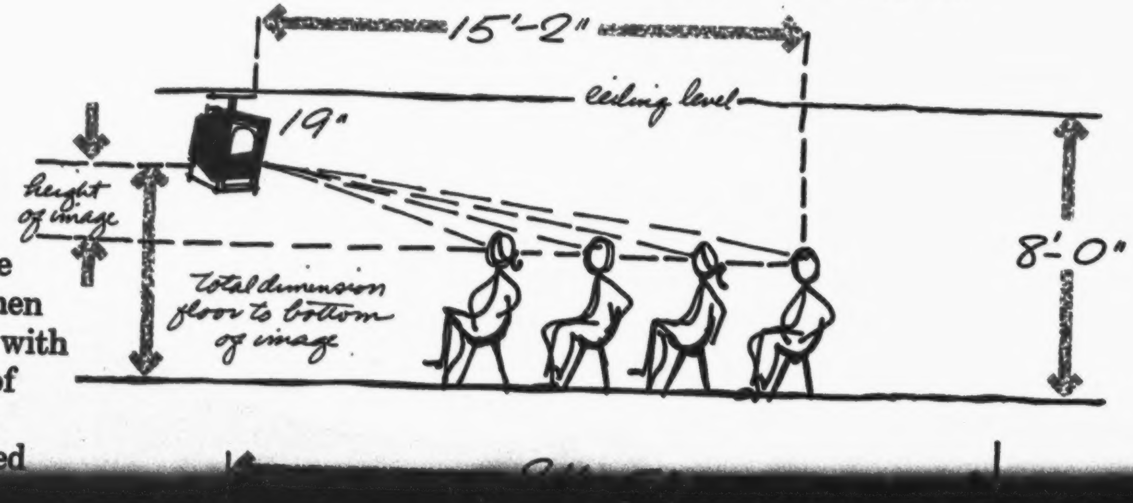
As of this date, the advantages of large screen television projection in school use do not outweigh the disadvantages (room must be darkened; cost of equipment demands full scheduled use with large groups in large rooms for economic advantage; sensitivity of equipment requires permanent installation, experienced operator and sharp maintenance to insure consistent picture quality).

Television receivers designed specifically for school use are generally 23″ units, front speakers with higher audio quality than standard sets (important in school use), some special placement of controls, higher cost than standard units.

Of standard receivers, the 23″ sets are produced in greater quantity and are more subject to "discount pricing" than the 24″ sets which only account for 5% of all sets produced. Before deciding on a set for price alone, consider quality, performance, and size audience you wish to reach.
Therefore we recommend:
*23″ and 24″ receivers as the optimums.**
Multiple images to be used for large group viewing.

NOTE: *At present the 19″ and 23″ tubes are the only sizes manufactured with the non-glare picture tube (see "lighting" notes, p. 45).

As the size of image increases, the vertical dimension of image to floor line increases. The limiting factor becomes the ceiling height. When the ceiling limit is reached and a larger image with larger viewing group is desired, the eye level of successive rows toward the maximum viewing distance must be raised or the seating staggered



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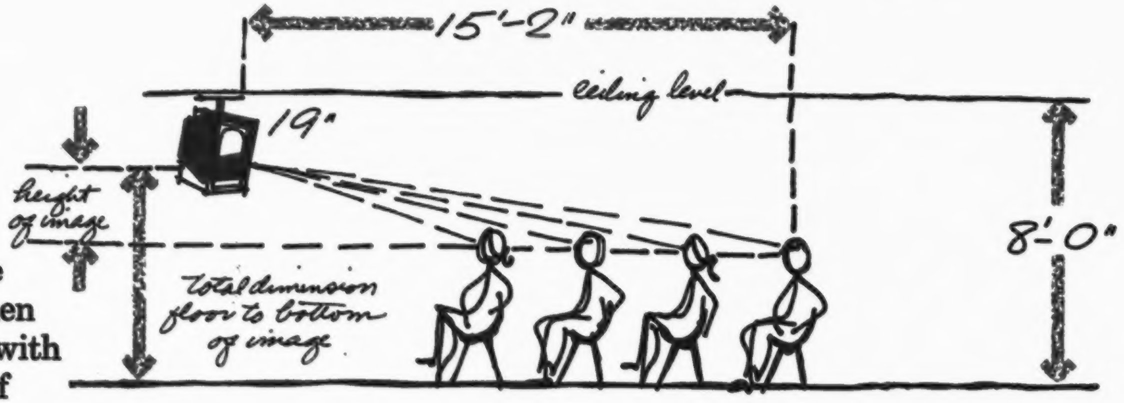
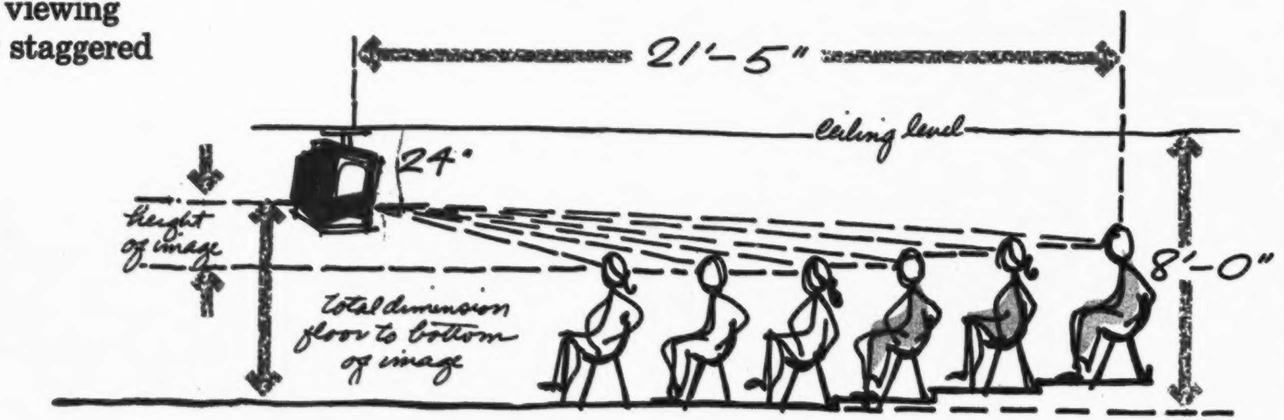
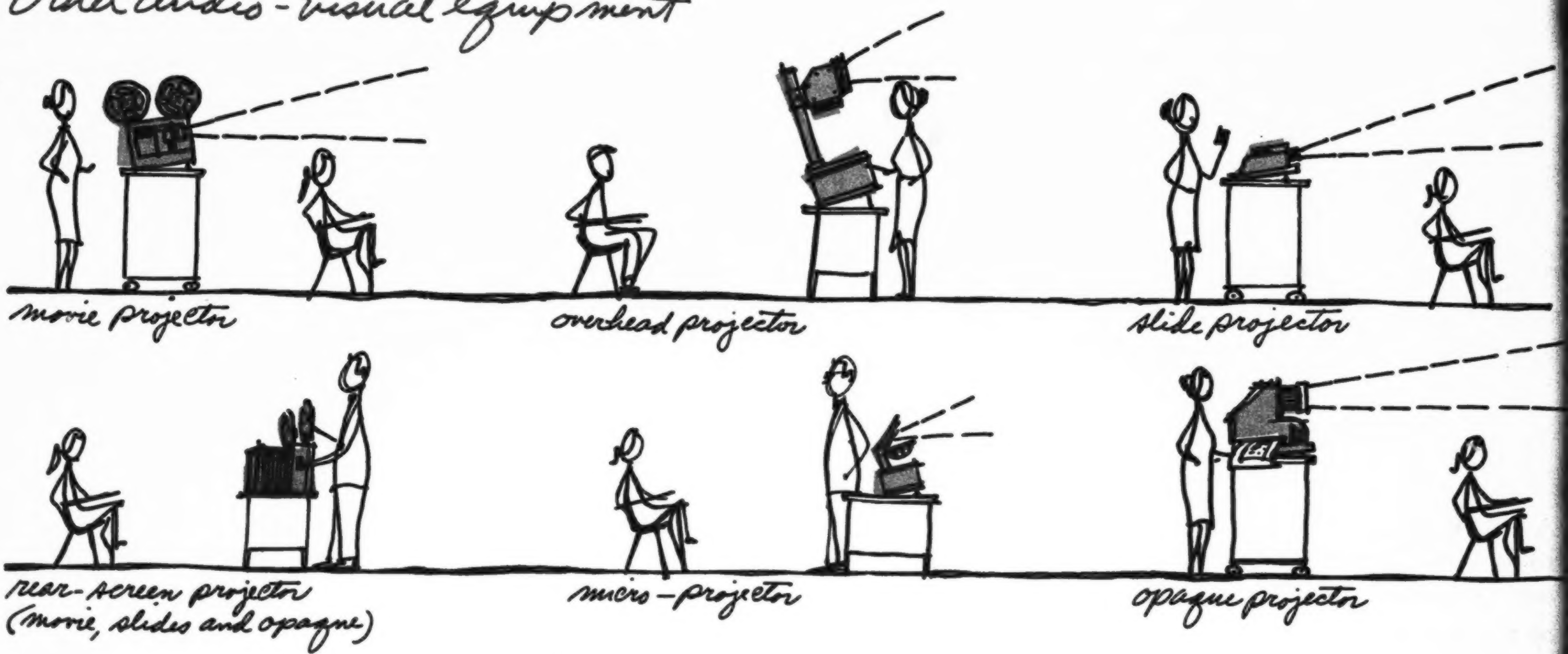




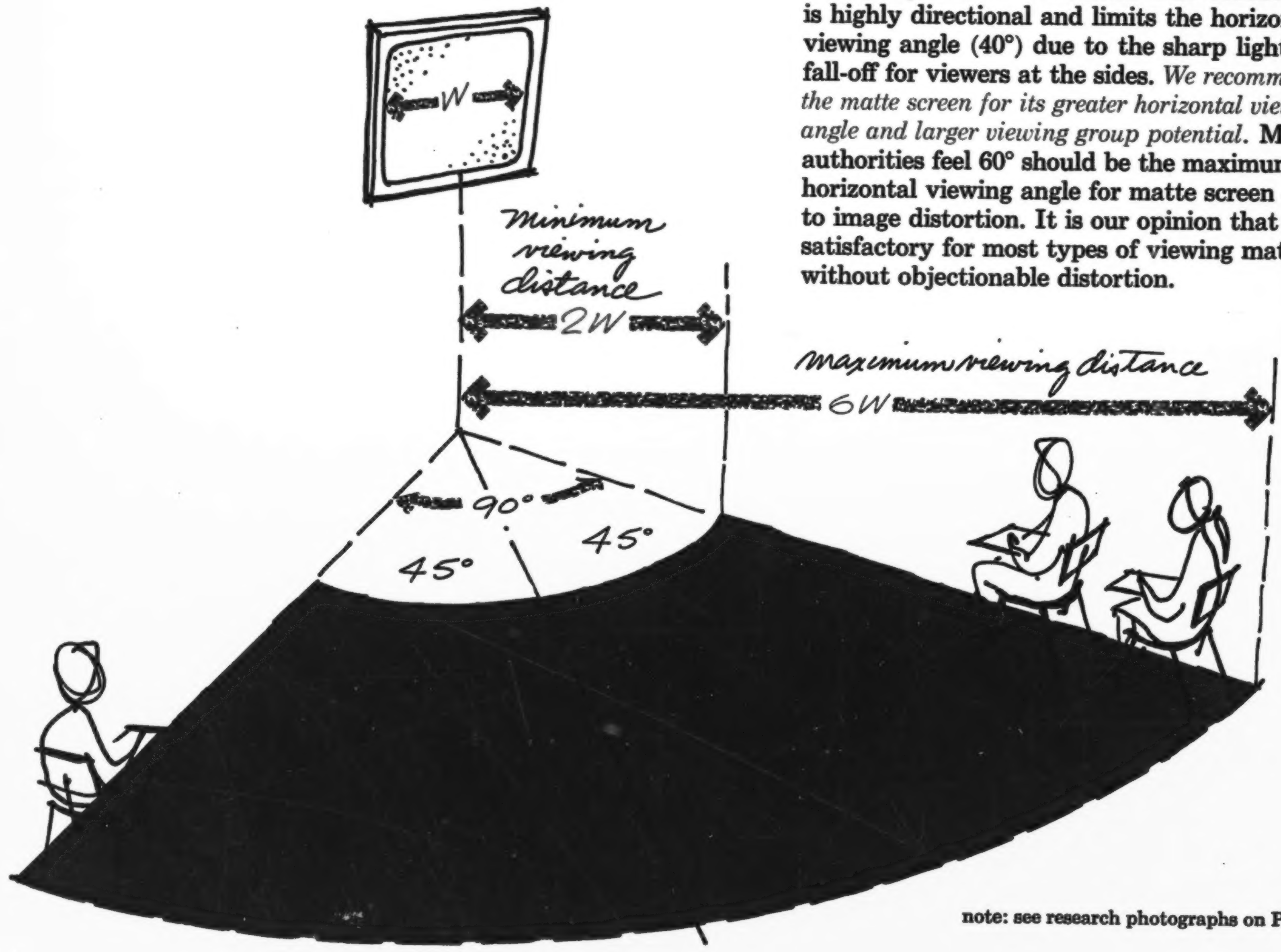
As the size of image increases, the vertical dimension of image to floor line increases. The limiting factor becomes the ceiling height. When the ceiling limit is reached and a larger image with larger viewing group is desired, the eye level of successive rows toward the maximum viewing distance must be raised or the seating staggered for optimum viewing.

NOTE: Diagram based on 12th grade, 3′-0″ in line seat spacing with 19″ and 24″ television receivers.

Other audio-visual equipment


movie projector
overhead projector
slide projector
rear-screen projector (movie, slides and opaque)
micro-projector
opaque projector

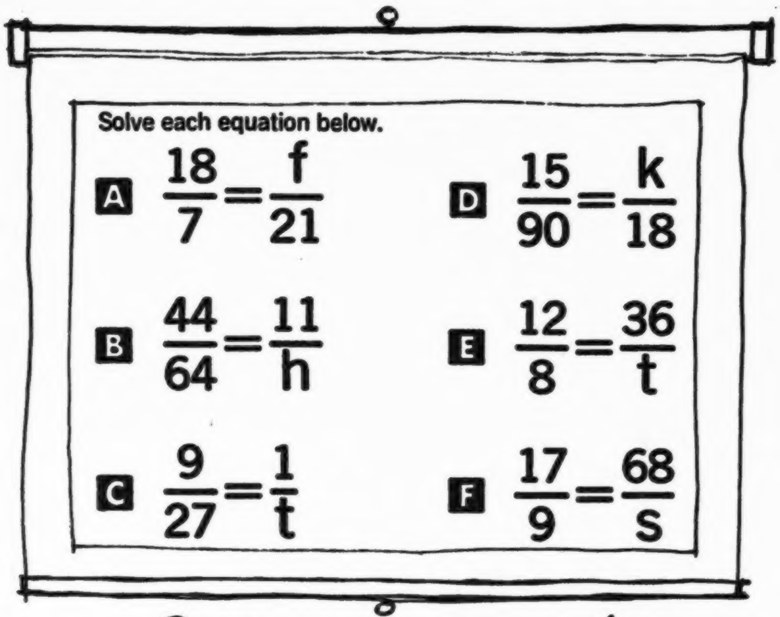
The beaded and matte screens are the two types commonly used in education. The beaded screen is highly directional and limits the horizontal viewing angle (40°) due to the sharp light image fall-off for viewers at the sides. *We recommend the matte screen for its greater horizontal viewing angle and larger viewing group potential.* Many authorities feel 60° should be the maximum horizontal viewing angle for matte screen due to image distortion. It is our opinion that 90° is satisfactory for most types of viewing material without objectionable distortion.


W
minimum viewing distance
2W
maximum viewing distance
6W
90°
45°
45°

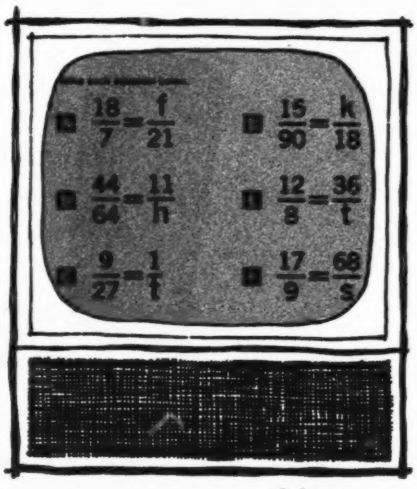
note: see research photographs on Pg.89

All educational material to be viewed on television should be prepared according to . . .

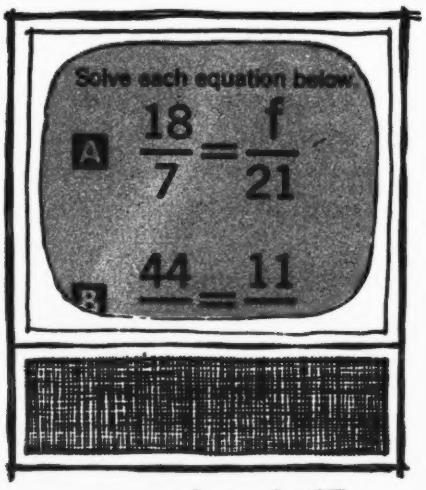
standards of legibility



20' maximum viewing distance



10' maximum viewing distance



20' maximum viewing distance

The following maximum distances require these minimum legibility standards:

maximum viewing distance	8′	12′	16′	20′	24′	28′	32′	64′	128′
minimum symbol size	¼″	⅜″	½″	⅝″	¾″	⅞″	1″	2″	4″

The minimum line spacing recommended is 1½ times the height of the letters. When upper and lower case letters are used, it is the height of the lower case that is the minimum symbol. These distances are based on the assumption of full range black and white contrast. Consideration should be given on television where there is a limitation in contrast range in reproduction.

In any viewing situation, what you see, how well, and under what conditions seeing takes place are the important considerations.

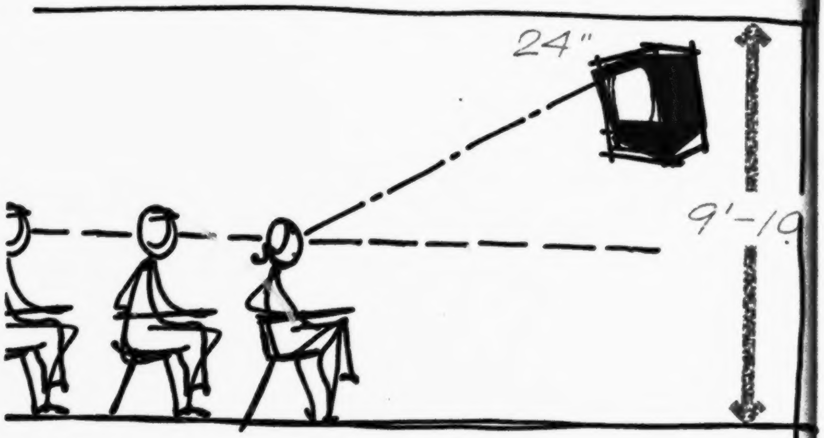
For the most part the common photograph, films, pictorial slides, etc., and material with bold elements in many cases can be viewed at greater distances than the 6 times the image width (6W) projection maximum and the 12 times image width (12W) television maximum.

There are, on the other hand, materials (i.e., typewritten material projected with opaque projector) that limit the maximum distance to less than 6W.

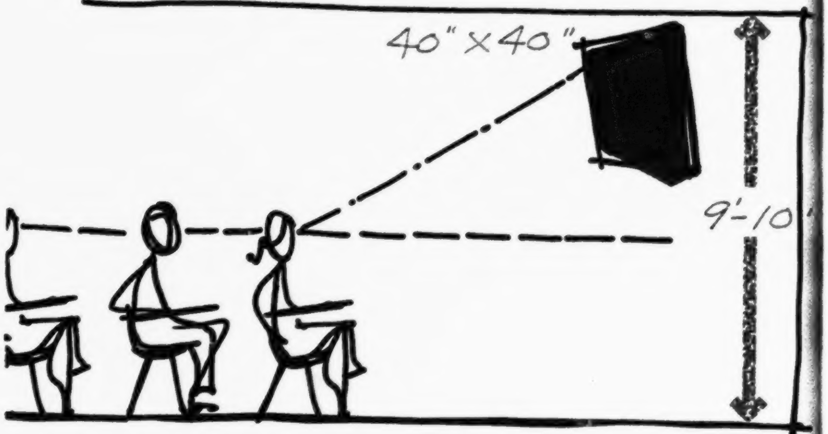
The 6W projected image and 12W television image maximum distances rule assumes legibility standards necessary for viewing material commonly used in education; i.e., letters, numbers, diagrams, etc.

In preparing visuals for television, black symbols on light grey or white symbols on dark grey should be used. Television calls for a bolder treatment than projected material. A general idea of the televised symbol effectiveness can be had by viewing it from a distance of 12W (an 8″ x 10″ card or photograph can be test viewed at 10 feet).

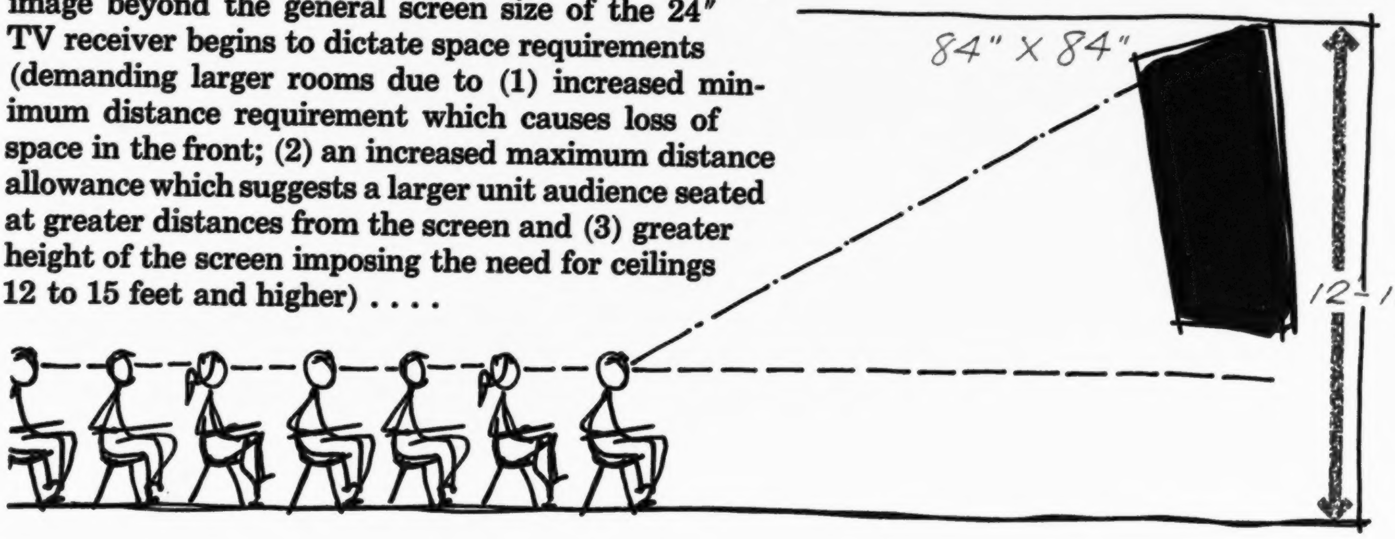
In determining minimum letter size for the 12W television viewing distance, the ratio of the height of the smallest symbol to the narrow dimension of the area of the art work for a full screen is 1/25. For 9″ x 12″ artwork, the height of the smallest symbol will be 1/25 of 9″ = .36″ or approximately ⅜″.



Since space requirements for television and the other educational audio-visual equipment are similar when images are close to the same size...



. . . and since large screen projection of the teaching image beyond the general screen size of the 24″ TV receiver begins to dictate space requirements (demanding larger rooms due to (1) increased minimum distance requirement which causes loss of space in the front; (2) an increased maximum distance allowance which suggests a larger unit audience seated at greater distances from the screen and (3) greater height of the screen imposing the need for ceilings 12 to 15 feet and higher) . . . .



Use techniques of large screen image projection only in those areas where the required high ceilings are also justified by the nature of a dual use of the viewing area (i.e., little theater, cafetorium, lecture hall, auditorium, etc.).

Limit the size of the teaching image to the size of a 24″ TV screen or approximately a 40″ projection screen (with a compatible size of viewing group) for learning spaces where one of the controlling space dimensions is a ceiling height of approximately 9 to 10 feet. It is possible to reach audiences of unlimited size even with restricted ceiling height by using additional TV receivers for audience sizes growing by multiples that vary with the size of the receivers used.

For the school with a closed circuit coaxial cable ETV system, it is possible to telecast films, slides and material normally projected and thereby reach as many receivers as there are in a system at any one moment. A projector and television camera chain combination is needed for this purpose.

With the promise of near-future developments of lower cost video tape equipment, these various forms of audio-visual material can also be recorded on tape and broadcast at will from the video tape recorder to multiple-set school groups of various size at any time to suit the need of the teaching schedule.

Environmental Factors

Of the environmental factors in school spaces, it would be difficult to give one a place of more importance than another. Acoustics, lighting, ventilation, color are so closely interrelated and each so complex that a brief review frustrates comprehensive discussion. The following notes, then, simply provide a groundwork for approaches to planning these factors as they relate to the facilities for schools.

Acoustics

It goes almost without saying that good hearing conditions are extremely important for instruction. In schools where television may be a new addition to teaching techniques, television itself does not pose unique acoustic or audio problems that do not already exist with or without the use of audio-visual devices. What, then, are the basic characteristics of hearing and sound problems in the school?

The ear is an extremely adaptive organ, able to pick recognizable phrases out of a babel of sounds. For example, in spite of the low roaring sound of an airplane engine, you can hold a fairly intelligible conversation with a neighbor in an airplane. But you find yourself exhausted after a plane flight filled with conversation because you have used your energy just to pick words out of the general haze of noise.

Some human energy is always expended in the process of hearing; the amount is relative to how good or bad hearing conditions may be. In a classroom where sound is ill controlled, the student diverts his energy from the learning task to the basic task of hearing. And the teacher must put out extra effort to speak loudly and clearly enough to get the message across.

Sound as we hear it is highly directional, like a light beam. It is created by rapid pulsations of air moving through space in waves of varying intensity. If the sound waves (such as those created by a teacher's voice) are adequately intense and clearly defined as they reach the ear of the student, sound is both audible and intelligible. If varying unrelated sounds of different types and intensity (screeching truck brakes, an overhead plane and a teacher's voice) all reach the student's ear at the same instant, what he hears is *noise* rather than intelligible sound.

Since sound waves are dissipated as they travel through space, they may lose their original strength (loudness) by the time they reach the ear that is far from the source. In this case the sound is inaudible and unintelligible.

When sound hits a hard, smooth surface (metal, glass, painted finishes) it will bounce or reflect. The pressure of the sound wave striking such a wall surface may also literally set the material pulsating like a drum head—consequently recreating sound waves on the opposite side so that you hear through the wall. If this surface is soft and absorbent instead of hard and reflective, sound will be muffled for the listener on the same side of the surface as the sound source. But *sound absorbent material will not prevent the transmission of sound to the next room;* this is normally accomplished only by density and solid mass, sometimes with an assist from an air chamber.

To achieve a good hearing environment within the school, planners must deal with problems of sound from two angles: A. *Control of sound that originates within the room.* B. *Exclusion of distracting sound that originates outside the room.* Taking reference from the previous notes on the characteristics of sound and hearing, some of the ways of dealing with problems of sounds within the school spaces can be summarized briefly as follows:

Room Shapes If a student in the last row is to hear what a teacher or another student is saying without benefit of amplification, it is clear that the distance from speaker to each listener should be equalized as much as possible. *Where it would also be suitable for functional purposes as well, then, a room should have comparatively even proportions of depth and width* (rather than an extreme dimension in either direction). This dimensional recommendation proves beneficial for sight as well as sound.

Reflection and reverberation are not major sound problems in comparatively small spaces for 30 or 60 or even 90 students. Reverberation time and bouncing sound does require more consideration when group size and room size increase beyond this point. Problems of reflection are intensified in spaces where walls and ceilings fit into regular parallel patterns. *Rooms with surfaces set at even slightly irregular planes will generally have better acoustical qualities than standard box shapes.*

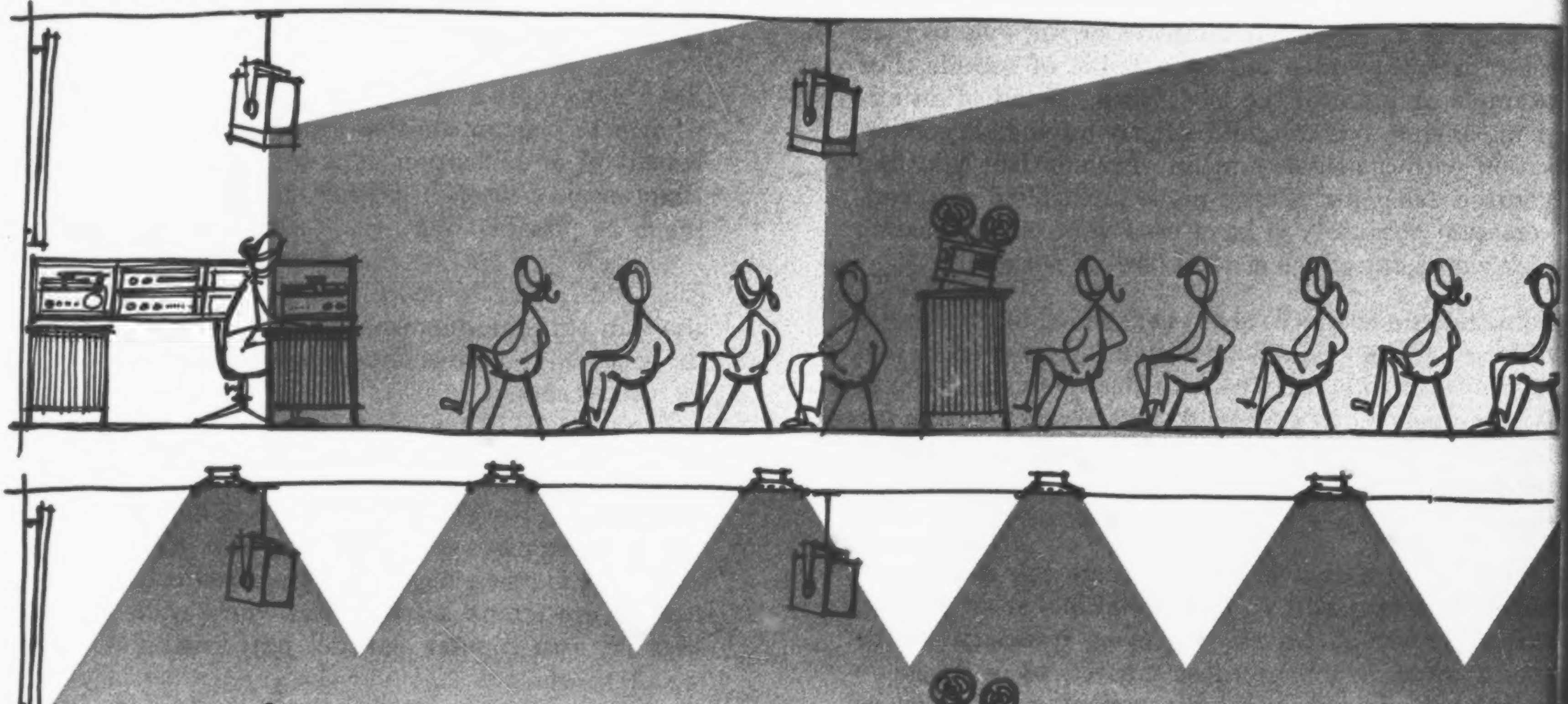
Sound conditioning materials The acoustic properties of a space should always be studied under in-use conditions. Students in a room not only create sound—they also absorb it due to the clothing they wear and their own physical presence. Materials used in the furnishing of the room such as draperies, blinds, cork boards, floor coverings are also effective in softening room sounds, preventing harsh or brittle sound effects.

Acoustical tiles, panels and acoustical finishes should be used with skill. Too much of a good thing can turn a benefit into a problem. Excessive acoustic absorption makes it unnecessarily difficult to make a voice heard across a room. Acousticians today recommend in many cases that only one-third of the ceiling in a conventional classroom be treated with acoustic absorbent—that third being the section farthest away from the teacher's center. By such acoustic planning, the teacher will actually use the untreated portion of the ceiling as a reflector to bounce the voice to the back of the room.

Elimination of noisemakers Every attempt should be made to eliminate disruptive noise at the source. One surface too often overlooked for its usefulness in sound control is the floor. Hard floor surfaces are not only sound reflective but are the origin of most disturbing sounds in the classrooms. *A soft floor covering, on the other hand, will muffle or eliminate disruptive sounds of dropping pencils and books, clicking heels or footsteps, scraping furniture.* The psychological effects of carpeting in the classroom also go a long way toward establishing natural disciplinary controls over both the sound output of the student and his general behaviour. Experience of schools in which carpeting has been used in experimental installations not only supports these comments, but indicates that carpeting is also economically feasible in school installations.

Improving sound systems Electronic amplification systems with most standard audio-visual equipment leave a good deal to be desired in the way of true fidelity of sound reproduction. Money spent for higher quality audio systems designed expressly for educational use (public address, television, phonograph, tape recording, projection equipment) is usually a wise investment. This is particularly so if the equipment is to be used for foreign language teaching where fidelity of sound is vital for effective teaching. The accompanying sketch also offers comment on the use of coordinated audio systems in large class areas.

In addition to controlling sound originating within the school spaces, planners must also deal with sounds



Of the various approaches to coordination of the various amplification systems used in large school spaces, two are illustrated in the sketches. One suggests that audio systems of multiple television receivers be used as centralized sources with special audio jacks for radio, tape recording, public address and film sound systems. A second approach suggests ceiling mounted speakers linked with a central audio control for all units at the teacher's center. Both techniques allow even spread of sound at low levels over an entire area.

originating outside, but entering the classroom through walls, ceilings and floors and through open doors and windows. Fortunately the major aim in sound conditioning to meet this problem is more simply the *reduction of sound transmission*, not necessarily complete mastery of the intruding noises.

Placement of the school plant Before a site is chosen for the school, consideration should be given to the location in relation to community noise sources. Setting a school as far as possible from a busy thoroughfare is the first step toward reducing intruding sounds. Placement of trees, outbuildings and architectural sound baffles between the street and the school proper can help to muffle or divert a portion of street sounds. Where disruptive street sounds enter through open windows in the summer, the installation of forced air circulation or complete air conditioning systems to allow sealing of the windows all year round has worked very effectively.

Intra-building noises The trend toward breaking a school into separate building units can be helpful in solving some sound problems. Since the space between units in itself provides a certain acoustic barrier, buildings can be so placed that naturally noisier group activities (gymnasium, cafeteria, music, shops) are in spaces facing the street and away from study, lecture and other quiet rooms—and in the case of music rooms, away from other noisy areas as well.

Inter-space noises Any partition or wall between two spaces is only as soundproof as the least effective acoustic section in that partition. If there is a thin wooden door without acoustical seal set into a thick concrete wall, sound will leak through the door and around it through cracks and openings as water through a sieve. Since heavy, solid partitioning walls with no openings are seldom practical in school layouts, some human controls are also necessary to avoid the distraction of sounds from one to another of two adjacent class spaces.

In the elementary grades, the cooperative planning of neighboring teachers in setting up common schedules for noisy group activities would insure against the possibility that one would be involved in a study hour while the other is holding a spirited group sing or demonstration. Soft masking noise from air conditioning, unit ventilators and other sources tend to offer some relief from intrusive sounds from the next room.

Space dividers The growing desire for flexibility in space has created a demand for movable partitioning devices. Before a movable partition is chosen for installation, school planners should make a careful study of the sound problems that will exist between two areas to be divided to determine the actual degree of sound transmission loss required. Manufacturers are currently pressing hard to develop acoustically improved partitioning devices to reduce transmitted sound sufficiently (see pages 52-53).

In the course of this design study and at the behest of EFL, the Chapman group has undertaken experiments with a new concept of a material for operable partitioning of spaces in the school. This material is based on the principal of achieving great density without porosity in a woven fabric which would retain linear qualities of draping and also offer the pleasant visual and tactile rewards of more traditionally woven fabrics.

A series of preliminary samples of the fabric (using a metal-core, nylon sheathed "fiber" laid in one direction only) were prepared on a handloom by weaving specialist Madge Friedman. She continued to work with the design group until a sample was prepared large enough in size for testing in the Riverbank Acoustical Laboratories. Transmission reduction tests completed in February, 1960 give promise that the flexible material can provide adequate sound-blocking efficiencies to make it effective as an area divider in the school. (See technical report on findings, page 88.)

Lighting

Dozens of books and reports on lighting have been reviewed by the design research team. In addition there have been as many meetings with illuminating engineers and scientists. The experts themselves will not voice a hard-and-fast agreement on general lighting specifications for the classroom.

What is the difficulty? The experts aren't hedging; they logically refuse to provide a single answer for a problem which has no single answer. *Proper lighting must be tailored to the specific need in each space—even for task-areas within the space. Quantity, quality and psychological effects all figure in the equation.* The combination of daylight and artificial light for the proper balance can be a tricky factoring problem.

What is the task for which you are providing illumination — reading? . . . writing? . . . sewing? . . . painting? . . . watching television? . . . just passing through a corridor? Obviously it is important to have lighting of proper intensities for different tasks, or else the student will unconsciously divert a good deal of his energy to the task of *seeing*, with less left for the job of learning. Appropriate lighting should be *planned for each* *area in which varying tasks may be pursued.* Movable fixtures and lamps as well as switching or dimmer installations can allow great functional variety.

Chalkboards should ordinarily have special fixed lighting—too often today a teacher doesn't realize that students can't see material on the chalkboard due to glare or insufficient illumination. Arts and skills areas in the corner of the classroom should have brighter illumination from overhead or special lamps. Except for some of the newest and most carefully planned schools, most classrooms today settle for a formula of general overall lighting that is inadequate for even the general task.

Is there such a thing as a general level of lighting for the classroom? In a sense, yes, since the major part of the student's time in regular classroom work is spent at the basic tasks of reading and writing. The concensus of lighting studies* indicates that a room with illumination of 35-70 footcandles will provide adequate brightness to undertake these viewing tasks with a minimum of viewing effort or strain. General room lighting requirements for special teaching rooms such as drafting rooms, sewing rooms, etc., are 100-200 footcandles and higher.

Quantity *of light is not the whole lighting story. The* quality *of the light at the point of the task is probably even more important.* Glare-free *are the key words here, since brightness alone cannot insure that a student will see a task before him if the material he is viewing is distorted by reflection or glare.* Glare can be controlled at two points—the sources of illumination and at the task. Reduction of glare at the source depends on the immediate source of light, design of the luminaire (the fixture), type of transmitting or diffusing shields and angle of the source to a glare-producing surface. Glare within the student's viewing angle depends on the degree of reflectivity or "glossiness" of the things he sees—paper, desk, nearby surfaces.

The student's concentration is also reduced if there are areas of strong contrast within his angle of vision—a very brightly lighted area adjacent to a dark area or an area of deep shadow. Unshielded or undiffused overhead lights are a major distraction. The raw brightness of sunshine entering a room or in view through a clear window causes acute visual strain. To avoid such distractions, lighting experts generally recommend comparatively balanced systems of room illumination and provision for control of quantity and quality of daylight and the view to the outdoors.

Holding devoutly to the do's and don'ts of the lighting engineer's bible, we might come up with a classroom as dull as a winter afternoon in London. Certainly this is to be avoided. High lighting adds excitement to demonstration or exhibit areas; low lighting produces more intimate psychological effects in counselling areas. *Lighting, like color, can inspire, call to attention, emphasize, according to the skill of the user.*

One of the great advantages of television over other audio-visual aids used to date is the fact that it does not require blackout of a viewing room. Indeed, room lights can be kept at levels adequate for taking notes without impairing the student's ability to see either the screen image or his notes.

A measure of the average brightness of the black-and-white image on a television screen (taken from the "Indian head" test pattern used in the industry) offers a figure of 35-40 footlamberts.* It has already been noted that the areas around the task image should not contrast excessively with the task itself. On that basis, general room lighting can be set at levels of approximately 30 footcandles or slightly higher. The face plate framing the picture tube should be light in value and matte finish to reduce contrast between the bright image and its frame and to avoid distracting reflections. The area adjacent to and behind the receiver should be lighted to levels just below the brightness of the frame to again avoid sharp contrasts with and around the viewing area.

Dimmers in the wiring system could provide room brightness control; or the job could be done more economically by wiring alternating lamps on multiple circuits controlled by a simple switch.

While this wiring is being installed, the school planner should also account for the demands of traditional film and slide projection techniques. Lighting will have to be reducible to 1½ footcandles for normal color projection; 4½ footcandles for black-and-white continuous tone projection; slightly higher for projection of most line drawings. Line projection with an overhead projector can be accomplished in a normally lighted room shielded from bright sunlight.

***Special reference to lighting studies at back of report.**

**The term* footcandles *is a measure of the amount of light falling on an object. How bright the object appears to the viewer is determined by how much of this light is reflected—a measurement called* footlamberts. *Since a television image is effected by light "passing through the tube" and seen directly by the viewer, its brightness is calculated in* footlamberts.

The one question posed most frequently by educators using television in schools across the country is "How can we get rid of the glare on the face of the television set?" *Some of the glare problems that exist merely emphasize the fact that the existing lighting in the classroom is poor to begin with. The strong light sources that cast hard reflections on the face of the set are probably producing glare in other areas as well, though the problem only comes into focus when television is introduced.*

Even proper overhead lighting, windows opening to a bright outdoor view and partially screened windows (especially with slatted shades), however, will produce glare and reflections that can at times completely destroy or appreciably impair visibility. When a single set is used in a room, a good part or all of this condition can be relieved by positioning the set in such a way as to avoid the angles that cast reflections on the set. This approach is seldom completely satisfactory. The addition of fins or a hood attachment extending from top and sides over the front of the set (matte finish) has met with some success. The use of dimming draperies of solid texture across the windows has helped in some instances.

More encouraging are reports from the industry on the new receivers now available or which will be available by the summer of 1960. One manufacturer reports considerable success in reducing glare by (1) slanting the glass in front of the picture tube and (2) using a tinted, glare-resistant safety plate. (The glare problem is alleviated, but positioning of the set is still critical.)

Corning Glass Works reports two approaches to the problem. With introduction of the laminated tube to receivers about a year ago they have reduced the potential number of reflecting surfaces from two to one.

In December, 1959, Corning demonstrated a non-glare cap for 19″ and 23″ laminated tubes that would reportedly eliminate the most bothersome reflections from room lights and windows. This tube is scheduled for delivery in Spring, 1960. The outside surface of the cap is treated with tiny droplets of glass permanently bonded to the surface to break up reflected images.

The supplier reported ". . . intensity of the non-glare treatment is carefully controlled so that there is no perceptible loss of picture definition and less than 1% of brightness when used on laminated tubes." (The design team viewed a demonstration of the non-glare tube functioning next to a standard tube. For the conditions of the experiment, the non-glare tube was eminently successful.)

Ventilation

Opening a discussion of heating, cooling and ventilating a school has dangers akin to placing your head between the jaws of a lion. You can't avoid the term *air conditioning*. But in so speaking, you will just as inevitably hear the echo of ". . . luxury . . . frill . . . frivolous . . . didn't need it in my day . . . schools closed during the summer anyway . . ."

Techniques of temperature, ventilation and humidity control are comparatively well known. Fuels and control systems come in assorted types and sizes and at varying costs with efficiencies that can be calculated.

The big question then, is more one of what you wish to do than the mechanics of how to do it. How do you rate the value of control of thermal environment in the school—how much can you afford to put into it—or leave out of it? What do you get for the dollar investment? *In terms of more learning for the students, better teaching by the staff and higher morale for all, it may be that the return is substantial, but it has not yet been measured in educational output to anyone's satisfaction.*

Books have been written on psychological and physical effects of thermal environment. Where air circulation is poor, air exchange inadequate, heat or cold in an extreme, mental and physical efficiencies are impaired. Where properly balanced thermal systems have been installed in schools, offices and factories, there are repeated reports of increased efficiency and morale as well as "bonus" rewards in the purification and cleanliness of controlled air for both personal health and considerable building maintenance savings.

The suggestion that most schools are closed during the summer months and therefore cooling and humidity control are not problems does not always follow the facts. First, demand is increasing across the nation for summer sessions, particularly at the high school levels, for additional study or makeup work. Second, heat emitted from lighting sources of ever increasing levels, from the sun and from the bodies of the students themselves will often raise the temperatures within a room to a point where forced ventilation or cooling is a necessity for a good portion of the normal school year.

There is no question that complete air conditioning of older buildings or air conditioning of schools built without accommodations for the mechanical equipment can be costly. It may often be less costly for old compact buildings which are being remodeled than for newer spread out buildings designed for natural ventilation. But improved equipment and promise of lower costs indicate that planners of future schools should consider air conditioning or the provision of future air conditioning for many parts of the country.

Color

Color in the schools is not restricted to walls and woodwork that are given a flat coat of paint. There is color in the structural materials that are left exposed in school areas—brick, stone, natural wood, brushed metal frames. There is color in the cork of the tackboard, in the brightly colored sketches in the display area, in the wall maps and the lighted aquarium. There is color in the chairs and desks and in the view of the outdoors. All of these should be considered along with the fact that the students in the school themselves provide a constantly changing spectrum of color.

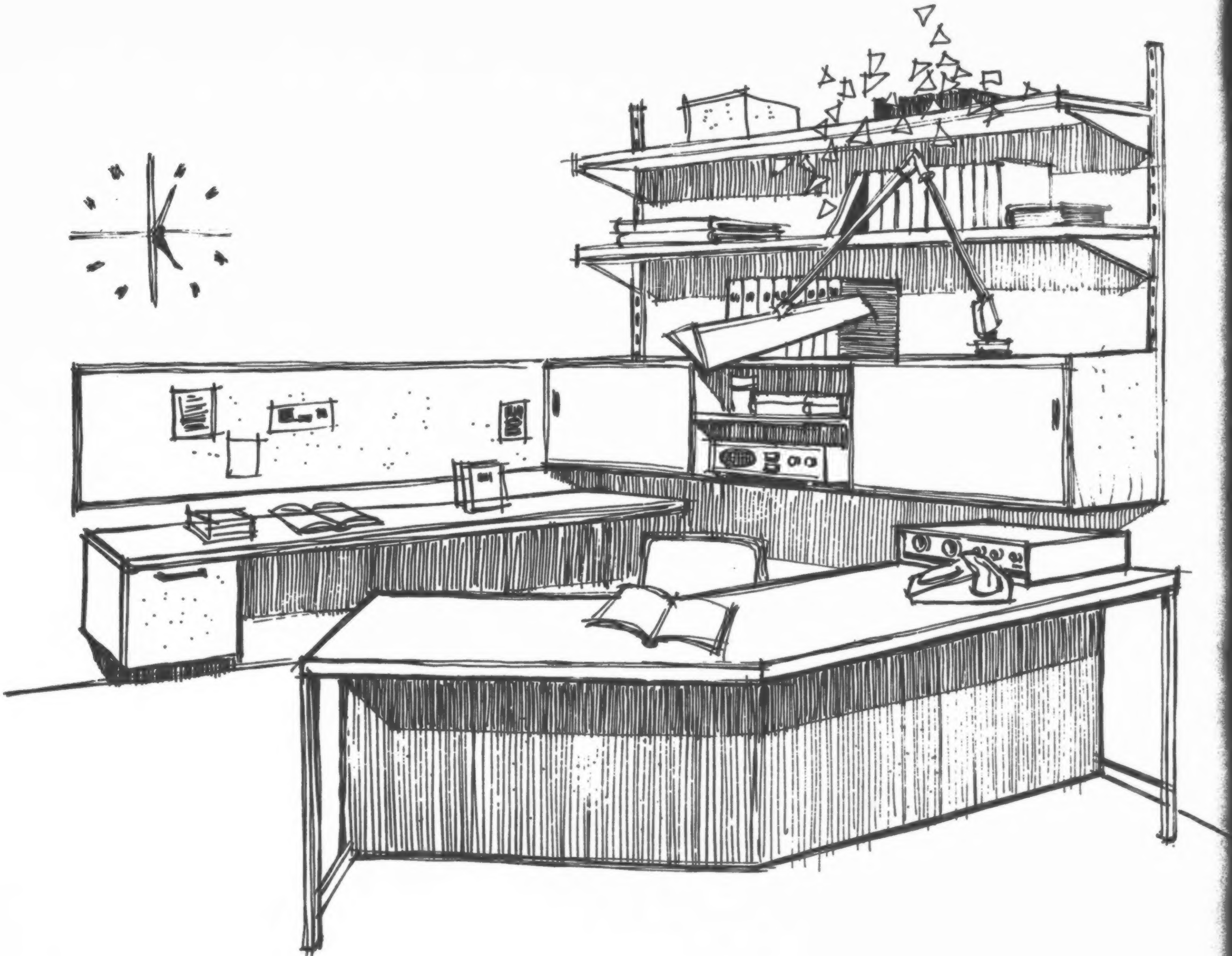
There are a number of approaches to the use of color in the school. Two that often seem contradictory are the scientific and the humanistic. A recommended two-step rule of procedure in dealing with both is:

1. *Review the scientific recommendations on the use of color as it relates to proper lighting in the classroom (basically the reflectivity and contrast factors*). 2. *Apply these recommendations without losing sight of the fact that the student is an impressionable bundle of responses—an individual who is affected by the environment in which he spends much of his life.*

In the primary grades the young pupil thrives on the excitement of the new world of the school and the experiences he is having for the first time. But his span of attention on any one subject is short. He can benefit from the stimulation of cheerful, bright areas of color.

As he approaches the middle grades the student begins to look for diversions from his routine tasks. The bright colors that were used to stimulate him when he was younger might now distract him from the job at hand. Color used in the study and work areas of the middle grades should be more subdued. But that does not mean that school areas where this student is supposed to change his pace of activity cannot be in exciting contrast to his study area.

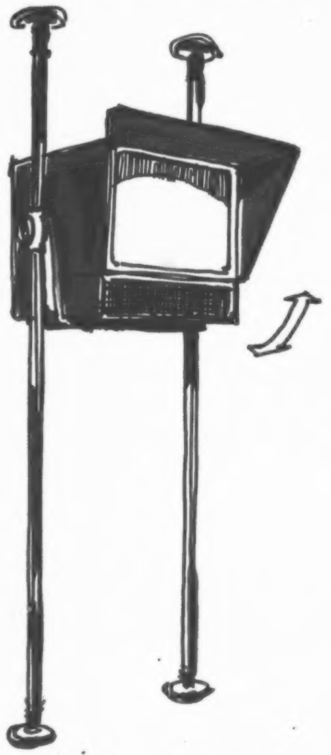
In many ways the trend in color and design of interior spaces of the high school is to become more sophisticated—to reflect the amenities of the adult world. Responses of the student in his middle teens are more subtle—and in many ways more sensitive than those of his juniors. Using color in the high school will demand more skill and imagination on the part of those who set the dyes.



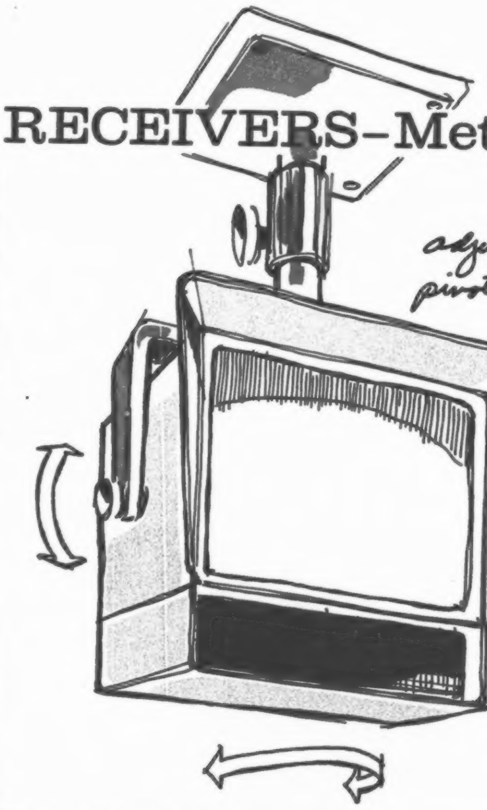
In interviews with educators across the nation, the design group noted that certain questions about school furnishings and equipment kept recurring. "How can we mount the television set? . . . Does anyone make a space divider that will . . . ? . . . What will the video tape recorder for the school be like? . . . Is there furniture suitable for cafeteria and lecture room? . . . "

And so the questions went. On the following pages we offer some answers in sketch form as suggestions of what the educators are seeking, to make those classroom spaces of the future school more effective teaching and learning spaces than are possible with currently available furniture and equipment. Some existing units come close to the sketches; others require modification to match the sketches; still others are in the process of product development. All can be part of the school plant and classroom of 1962.

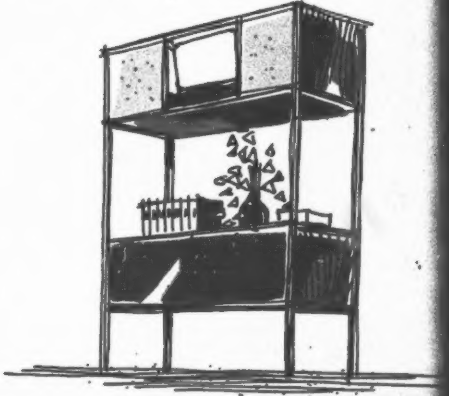
TELEVISION RECEIVERS–Methods of Support



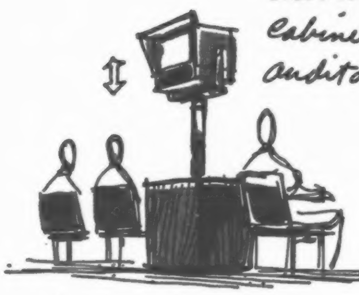
adjustable pole mount floor to ceiling support



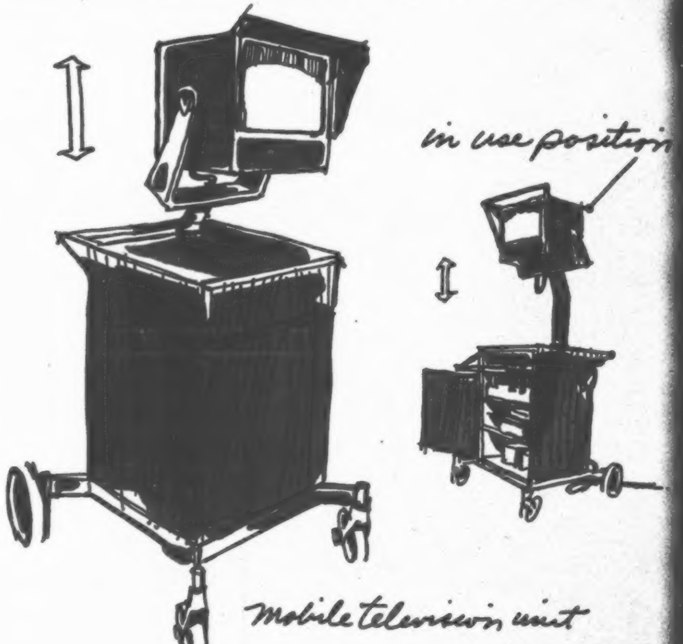
adjustable and pivoting ceiling mount



furniture cabinet television, radio record player, etc..

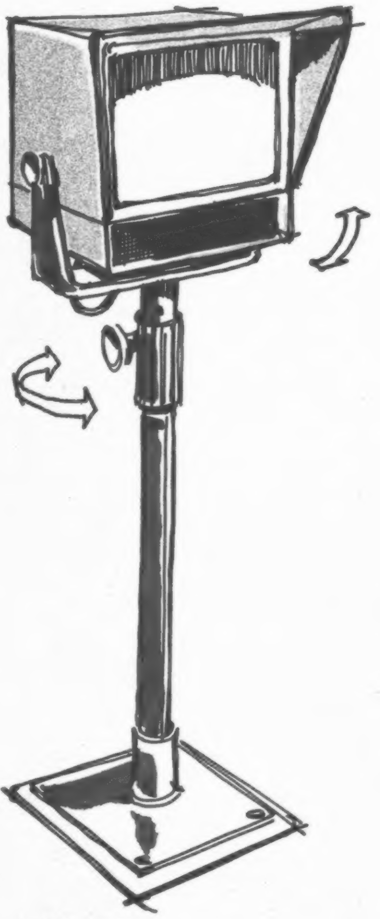


retractable television in cabinet for auditorium

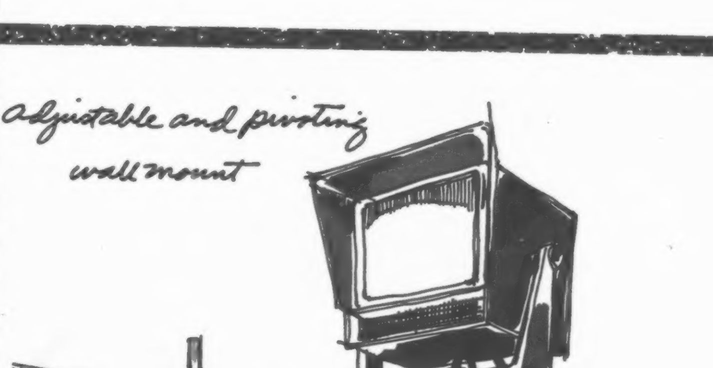


in use position

Mobile television unit



adjustable and pivoting floor mount



adjustable and pivoting wall mount

There is a need for adjustable devices to support the television receiver whether ceiling, wall or floor mounted or mobile.

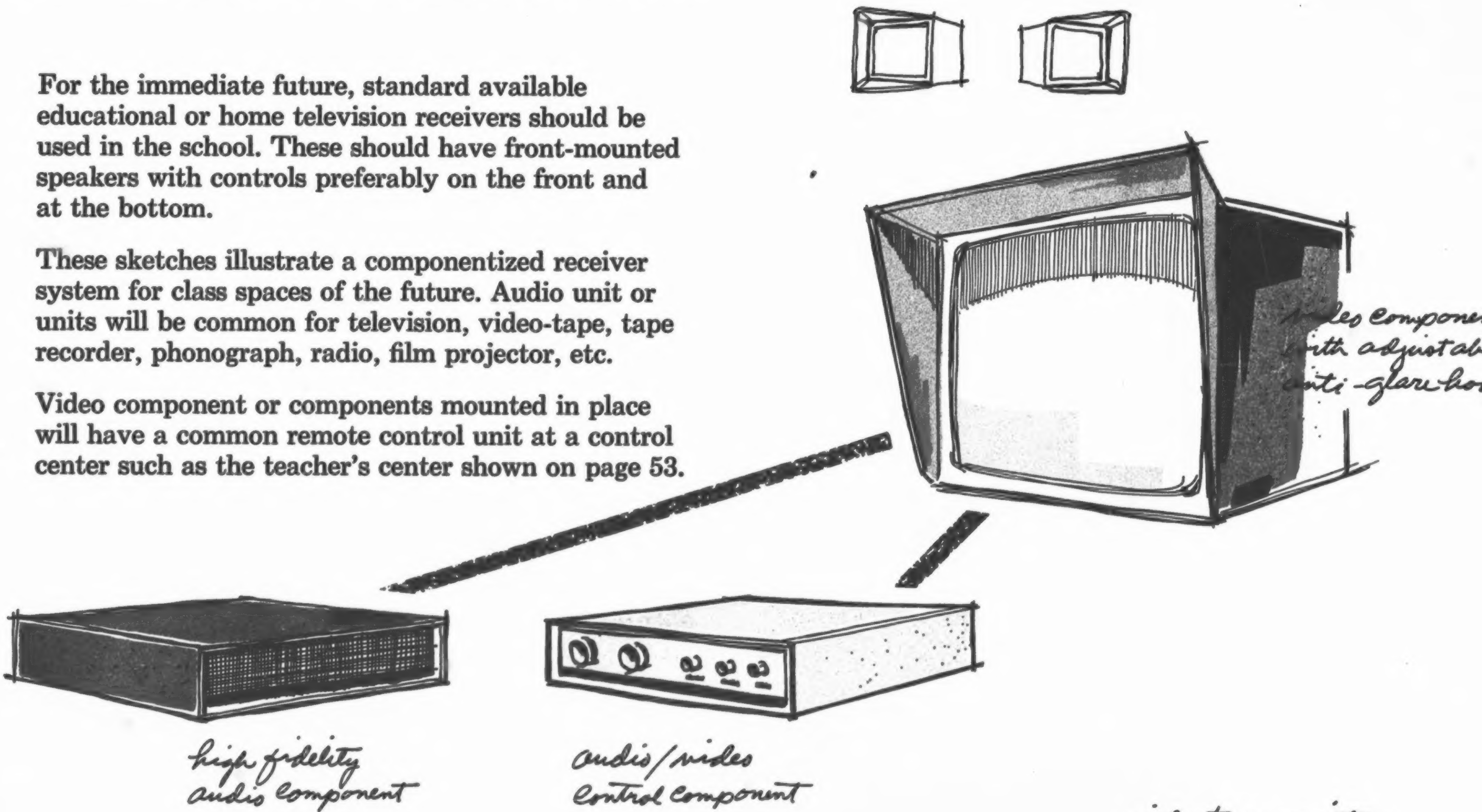
These are sketches to illustrate some of the ways this can be achieved. Some parts can be easily fabricated in a shop; others will require some tooling investment by manufacturers.

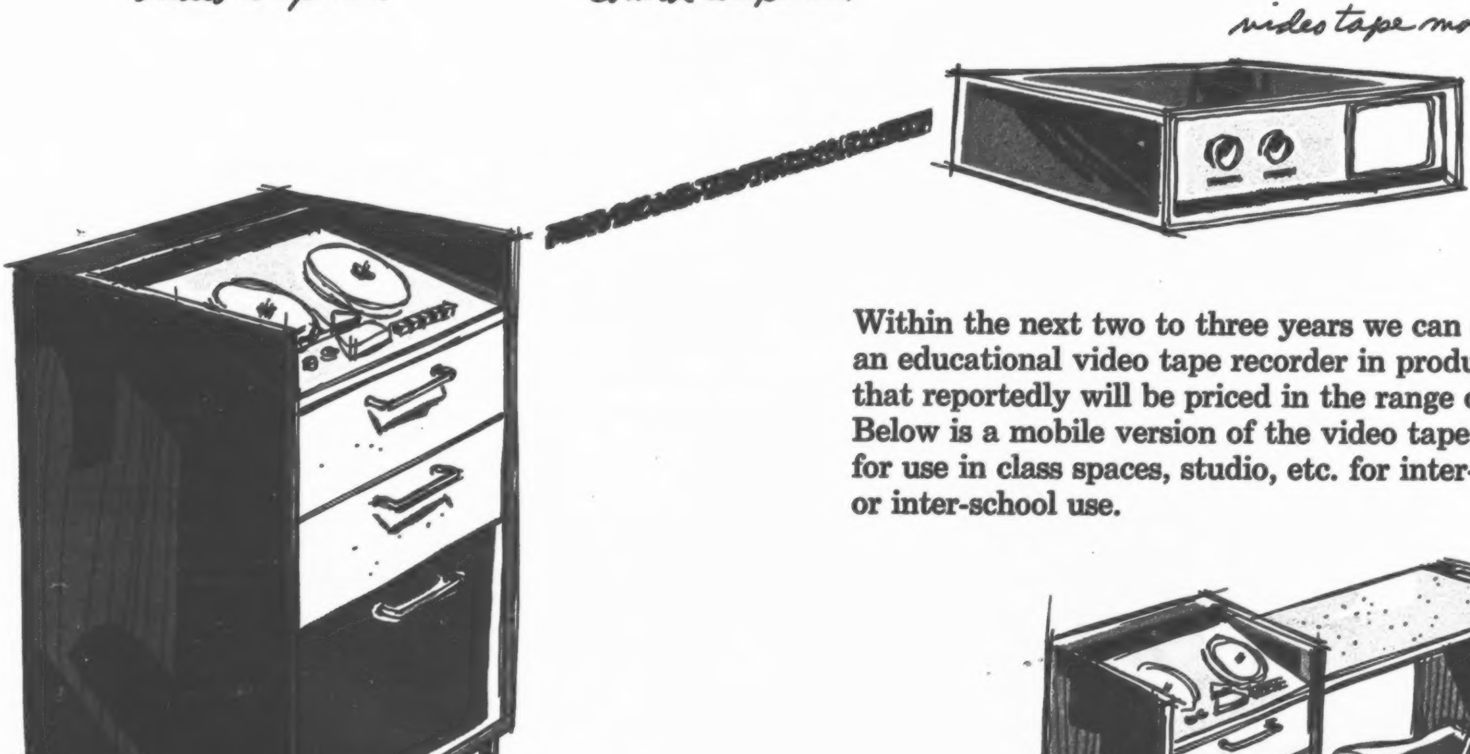
TELEVISION COMPONENTS

For the immediate future, standard available educational or home television receivers should be used in the school. These should have front-mounted speakers with controls preferably on the front and at the bottom.

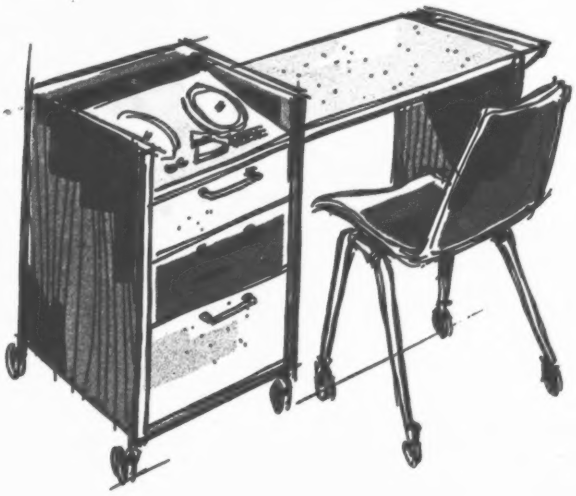
These sketches illustrate a componentized receiver system for class spaces of the future. Audio unit or units will be common for television, video-tape, tape recorder, phonograph, radio, film projector, etc.

Video component or components mounted in place will have a common remote control unit at a control center such as the teacher's center shown on page 53.

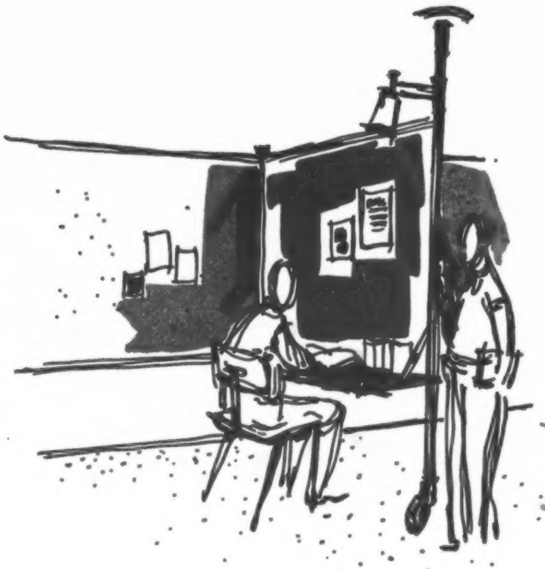

video componen
with adjustab
anti-glare-ho
high fidelity audio component
audio/video control component


video tape monitor
video tape recorder

Within the next two to three years we can expect an educational video tape recorder in production that reportedly will be priced in the range of $10,000. Below is a mobile version of the video tape recorder for use in class spaces, studio, etc. for inter-building or inter-school use.



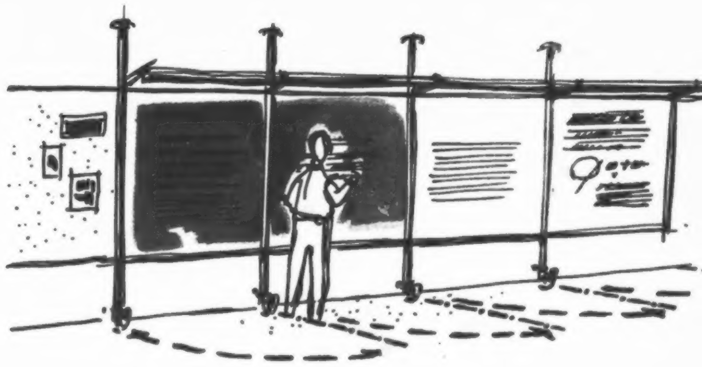
SPACE DIVIDERS

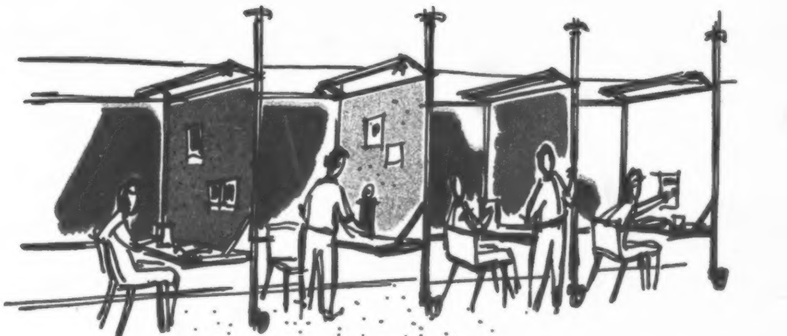


suction cup at ceiling
adjustable pole

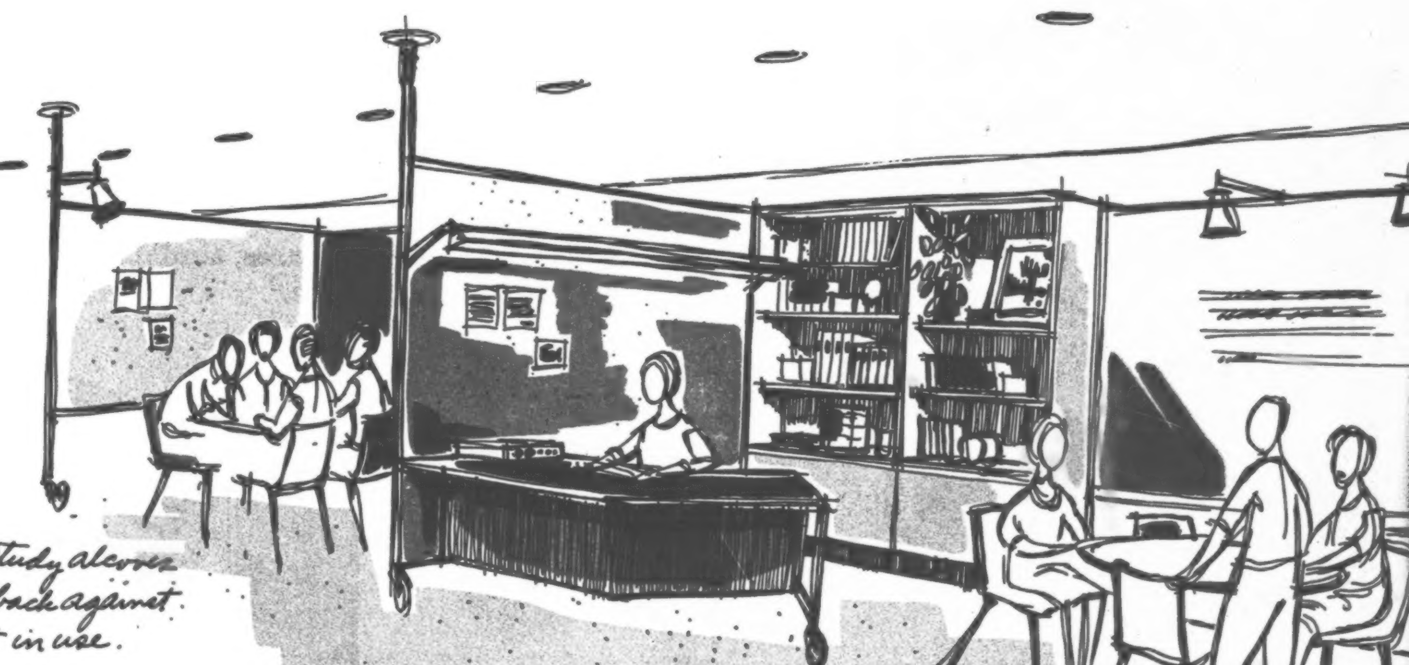
locking caster

hinged cork, perforated board
or chalkboard panels - some
with attached horizontal
work surfaces.



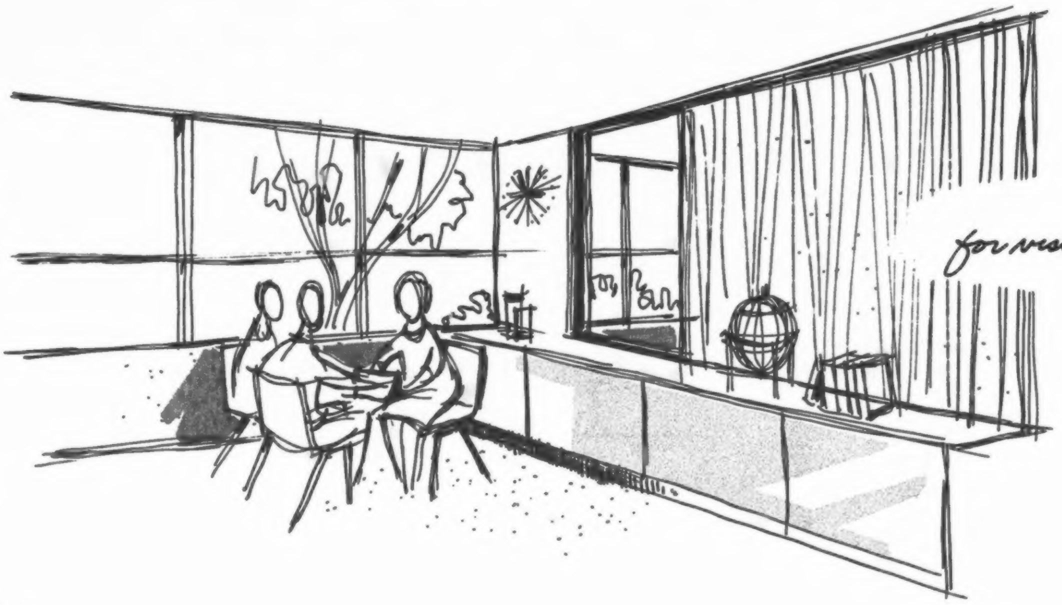


individual and double pupil study carre
in class spaces, library, resources cente
language lab, etc...

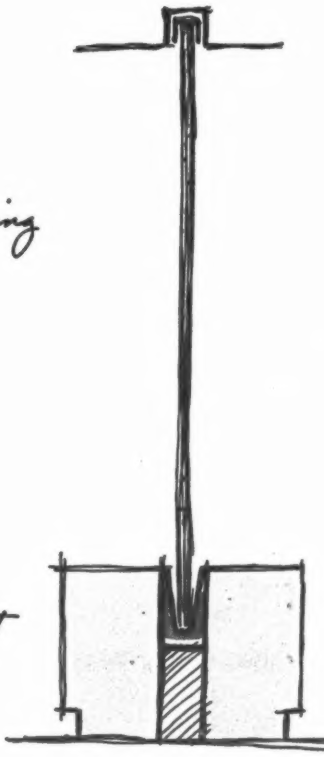


Small group study alcoves
divider rotates back against
wall when not in use.

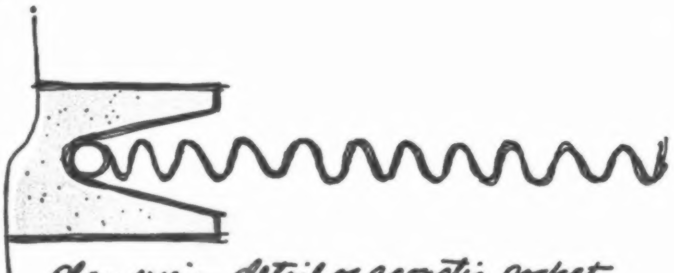
Counselling center - mobile desk unit



for visual opening

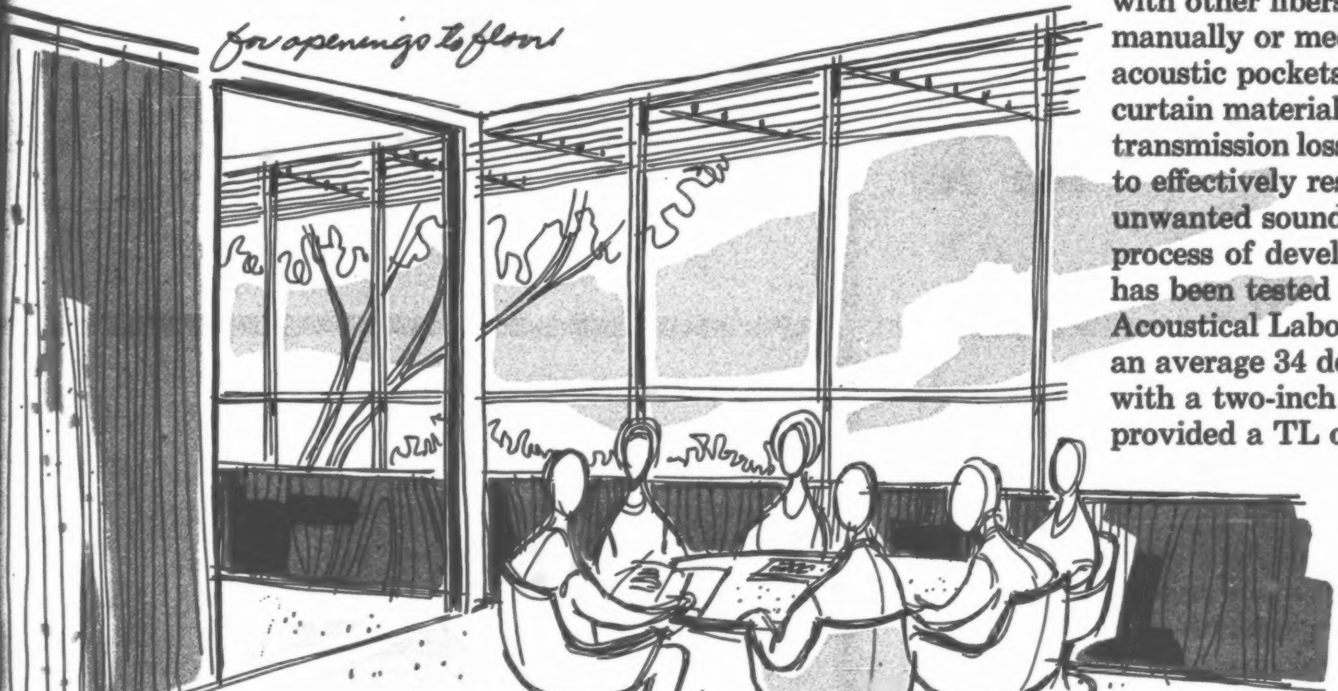


wainscot with pocket to baffle sound



plan view—detail of acoustic pocket

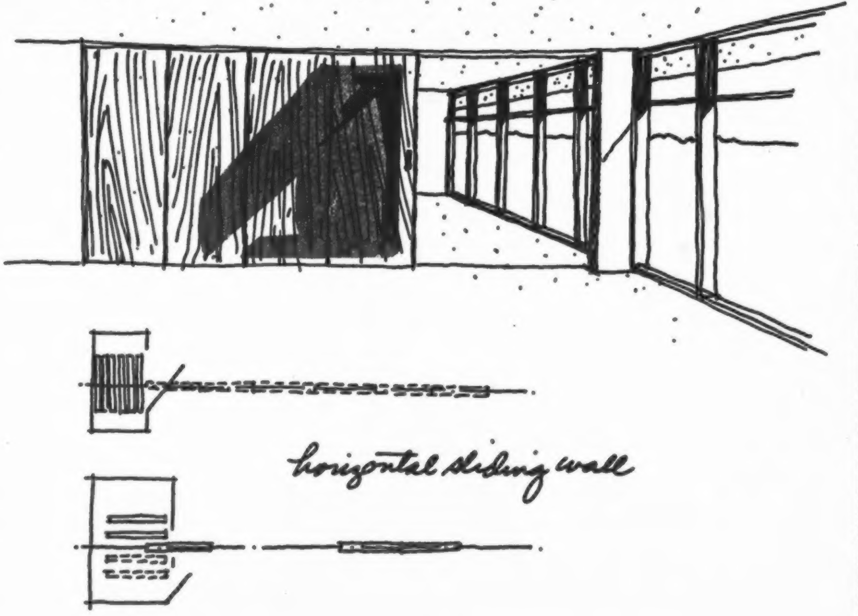
In the near future—an acoustic curtain for division of spaces. This curtain, of metal filament interwoven with other fibers, would be operated manually or mechanically. With acoustic pockets at all edges, the curtain material will have a sound transmission loss (TL) rating sufficient to effectively restrict passage of unwanted sound between spaces. In process of development at present, it has been tested at the Riverbank Acoustical Laboratories and rated at an average 34 decibel TL. Two layers with a two-inch air space between provided a TL of 43 decibels (aver.).



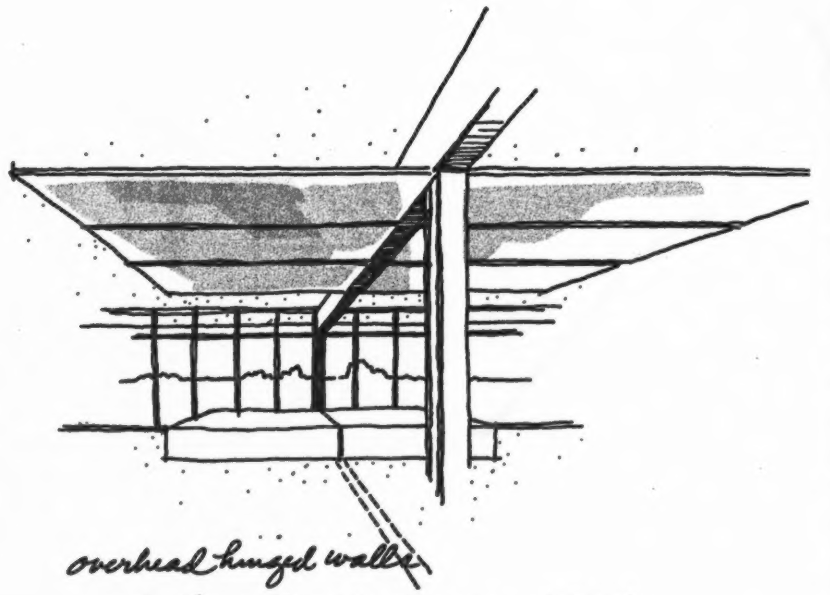
for openings to floor

track at floor or thick fringe to baffle sound

SPACE DIVIDERS

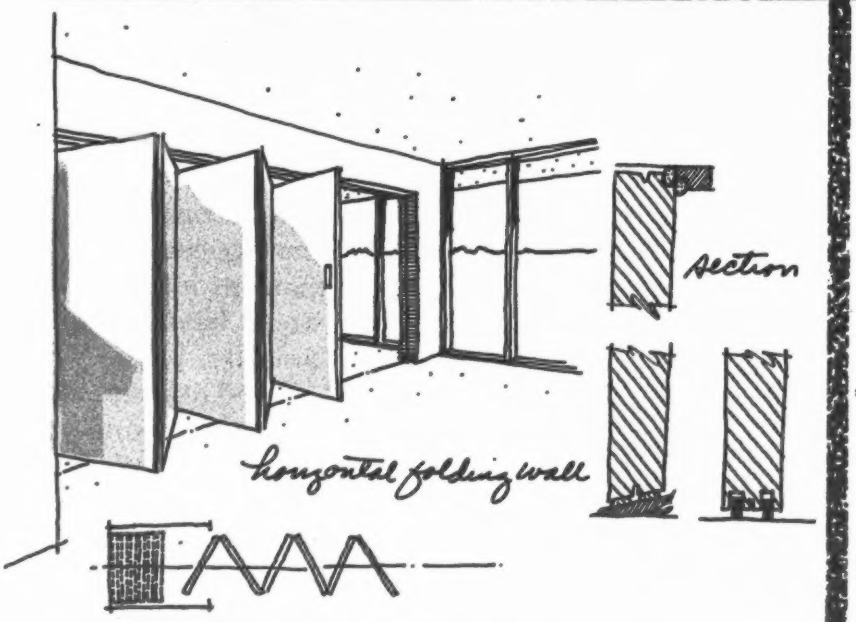


horizontal sliding wall

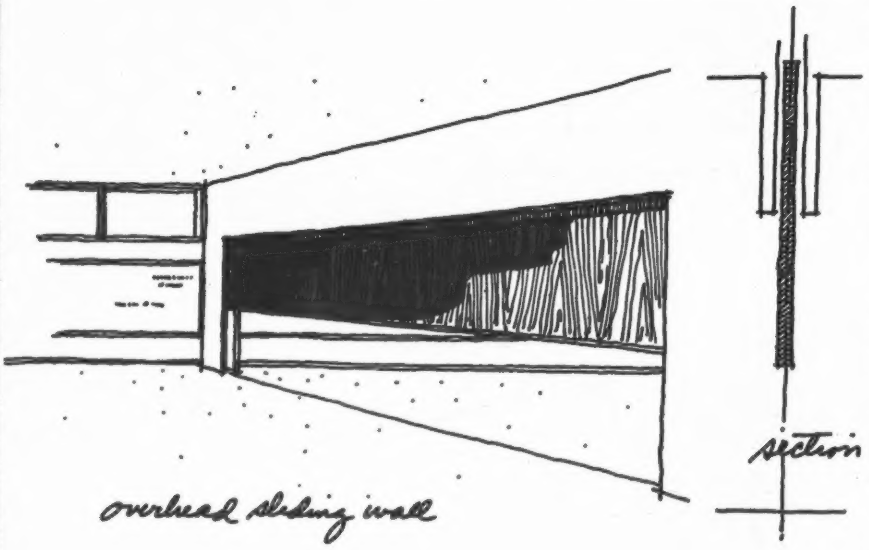


overhead hinged wall

Architect: Caudill, Rowlett and Scott

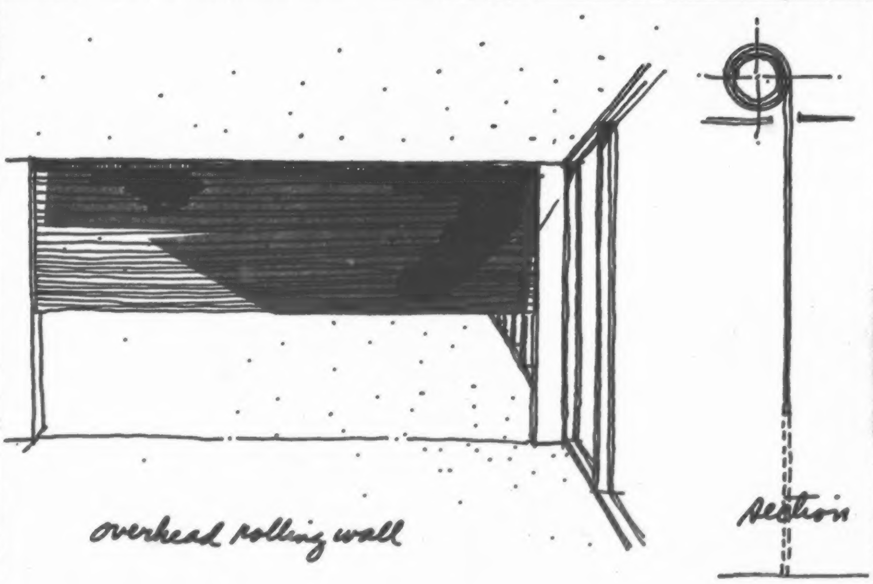


horizontal folding wall



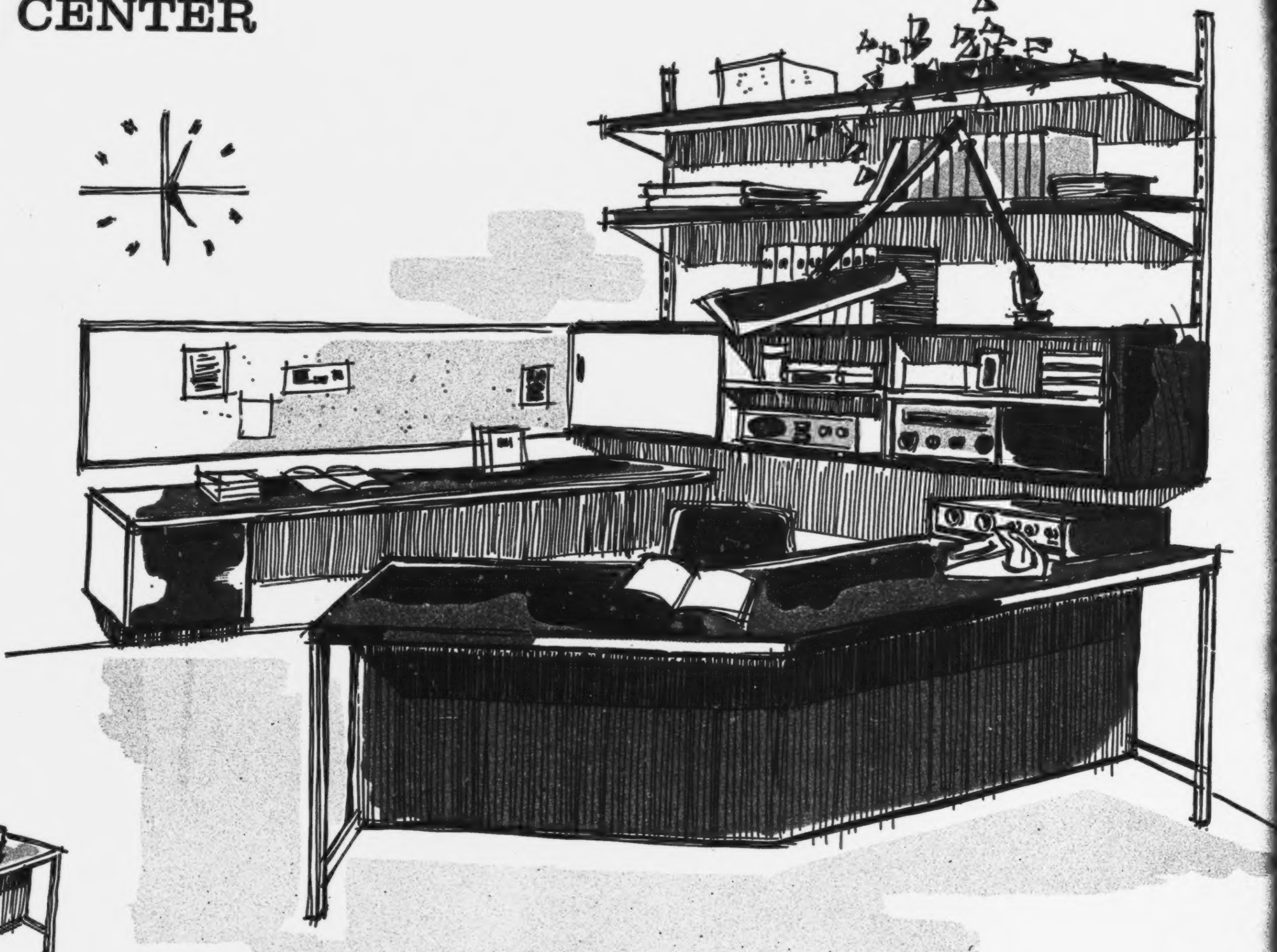
overhead sliding wall

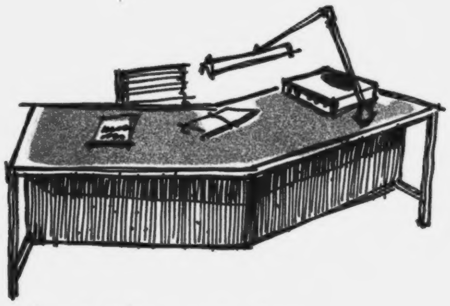
These are some of the basic types of operable partitions available today. Since manufacturers are becoming more conscious of acoustic requirements for educational use, there will be developments in the near future to answer these needs more effectively. The sound shear principle as developed by Bolt, Beranek and Newman is a step in this direction. The office type movable partitions are not included here since they are not operable in the same sense as those shown.



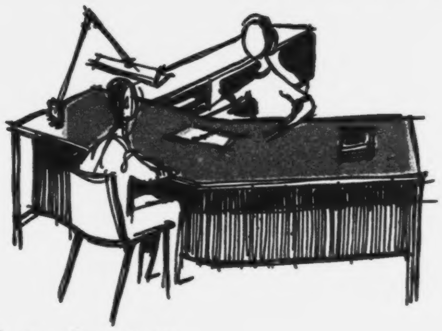
overhead rolling wall

TEACHER'S CENTER

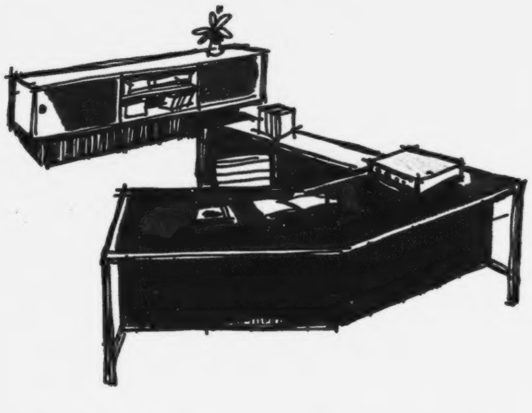




basic teacher's desk



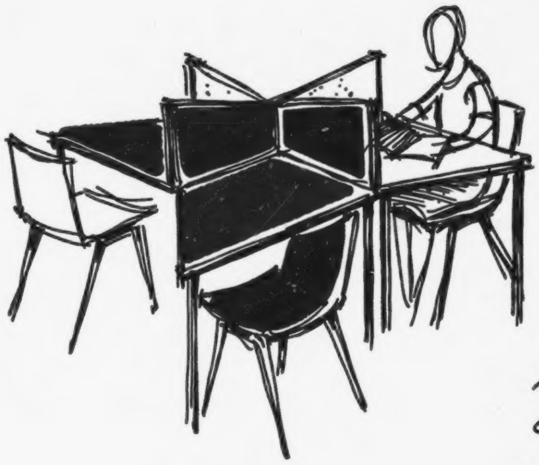
desk with "ell"

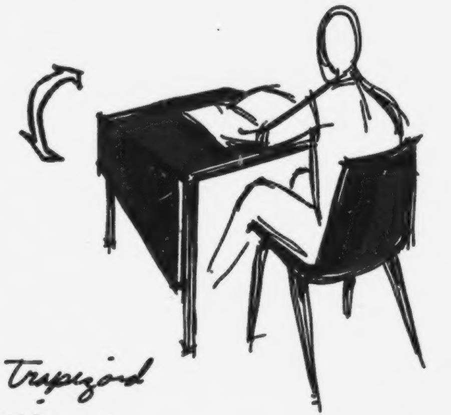


desk with "ell" and wall cabinet

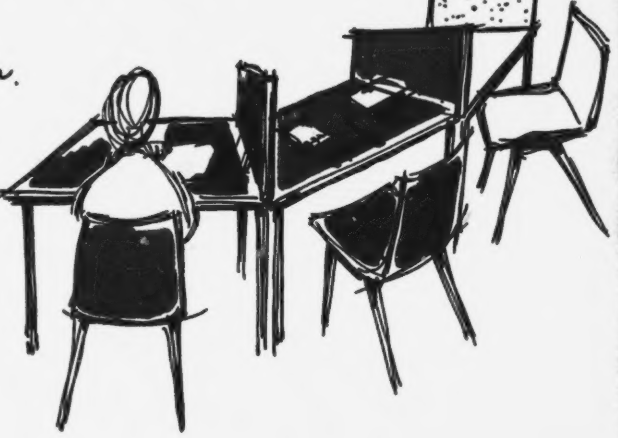
The teacher's center in the future school will be more than just a desk and chair. It will be a work center for the teacher, with reference material, files and supplies close at hand. It will serve as a suitable area for counselling, and possibly for small group activity which the teacher can lead. It will be a control center for electronic equipment in the learning area —lighting, partitioning devices, intercom and public address system, etc. It will be so designed as to be both efficient and attractive —a place where the teacher will want to work and the student will want to visit.

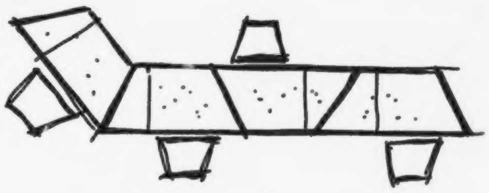
FLEXIBLE FURNITURE

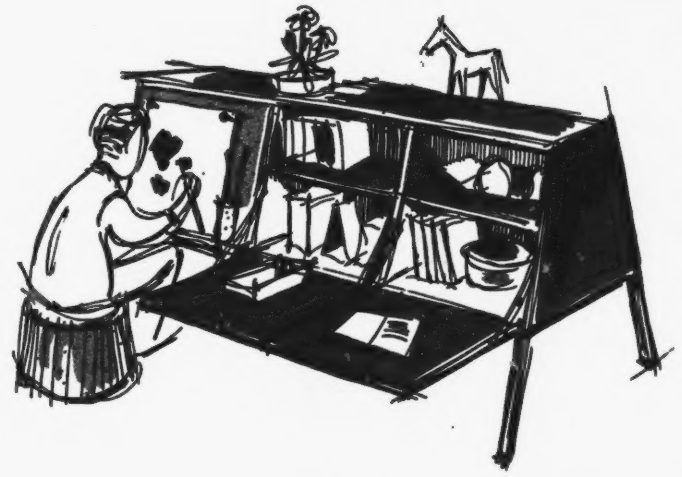




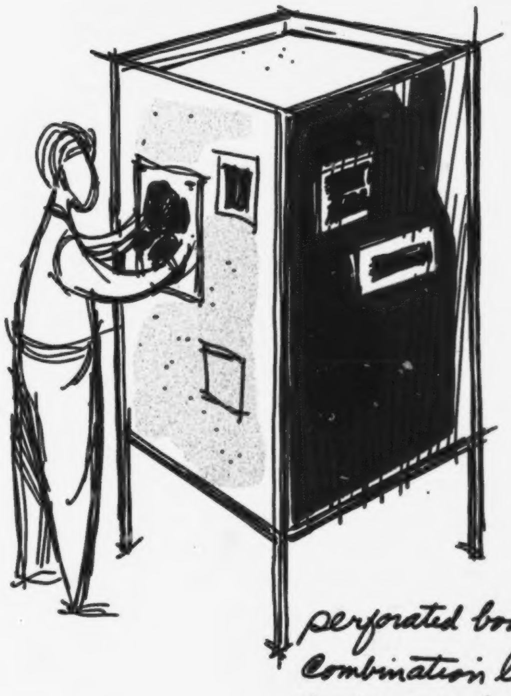
individual study unit, trapezoid
shape, groupable in various
combinations, drop leaf for
larger work-top, also as a divider.





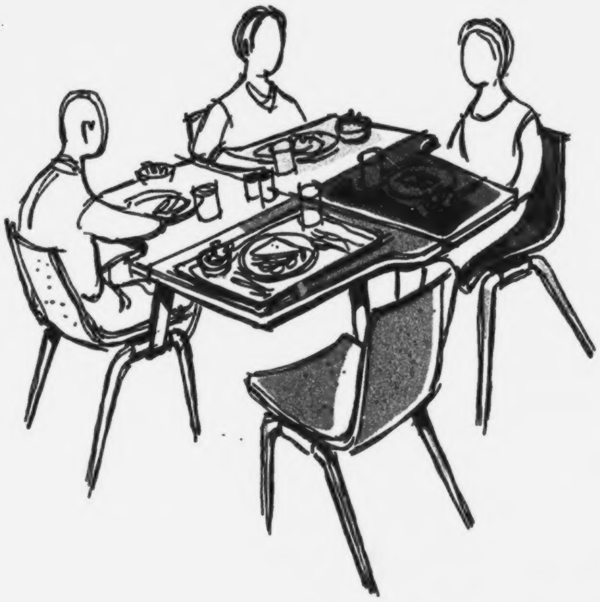


surfaces, storage for
related equipment.

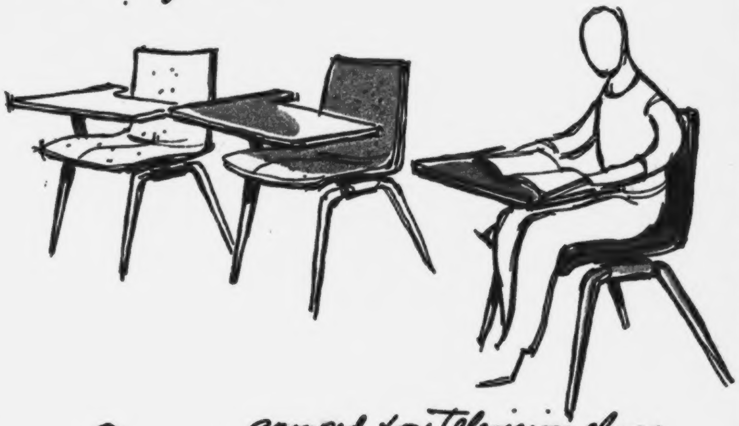


perforated board or corkboard
combination learning/teaching
surfaces and storage –

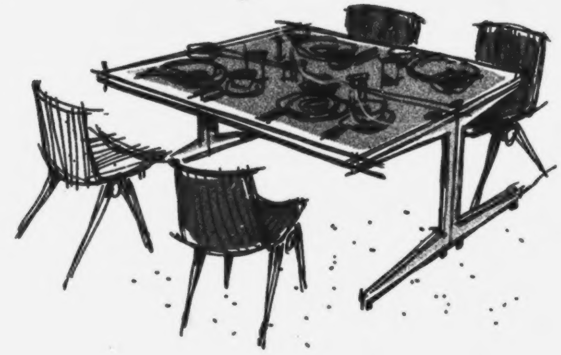
Convertible cafetorium classroom study and television viewing units:

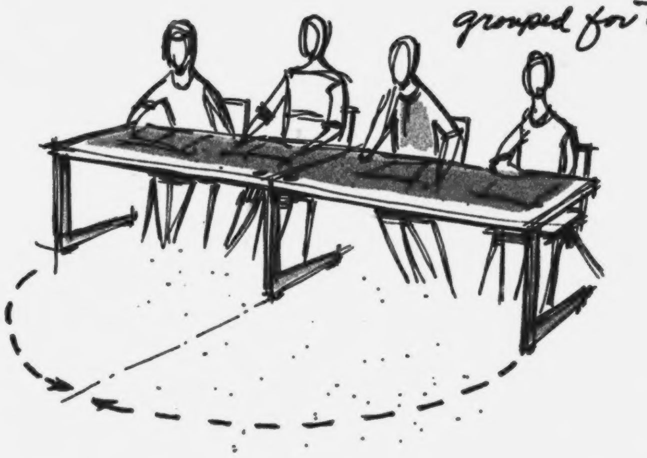


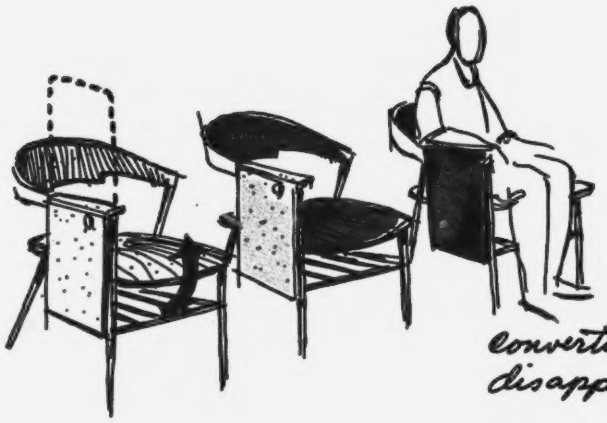
grouped as lunching unit

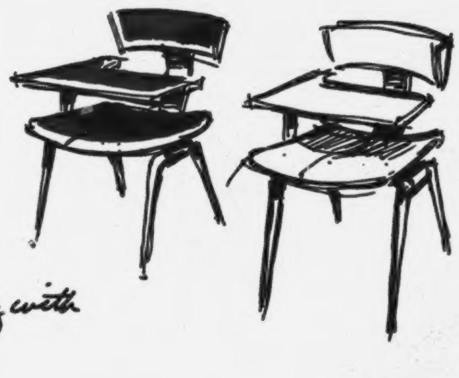


grouped for television class

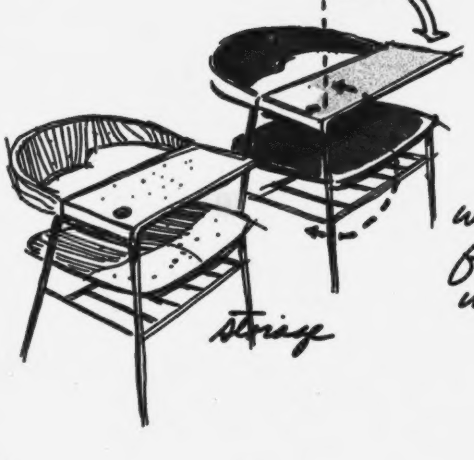




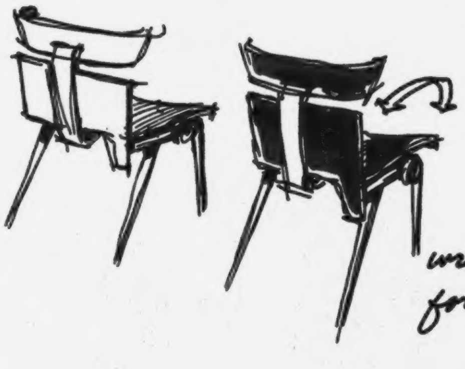




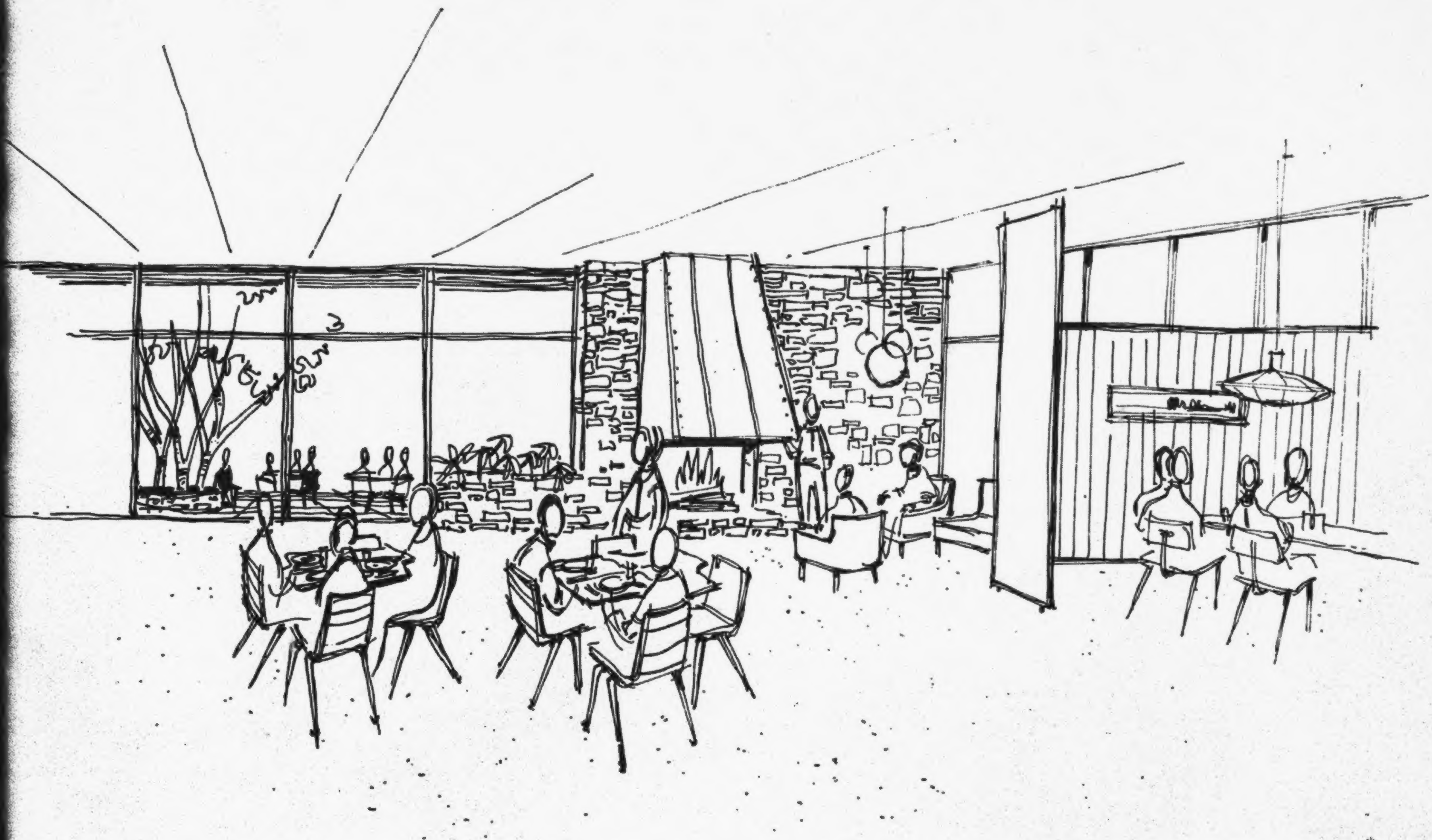
convertible lecture space seating with disappearing writing surface.



writing surface rotates forward and down into use position

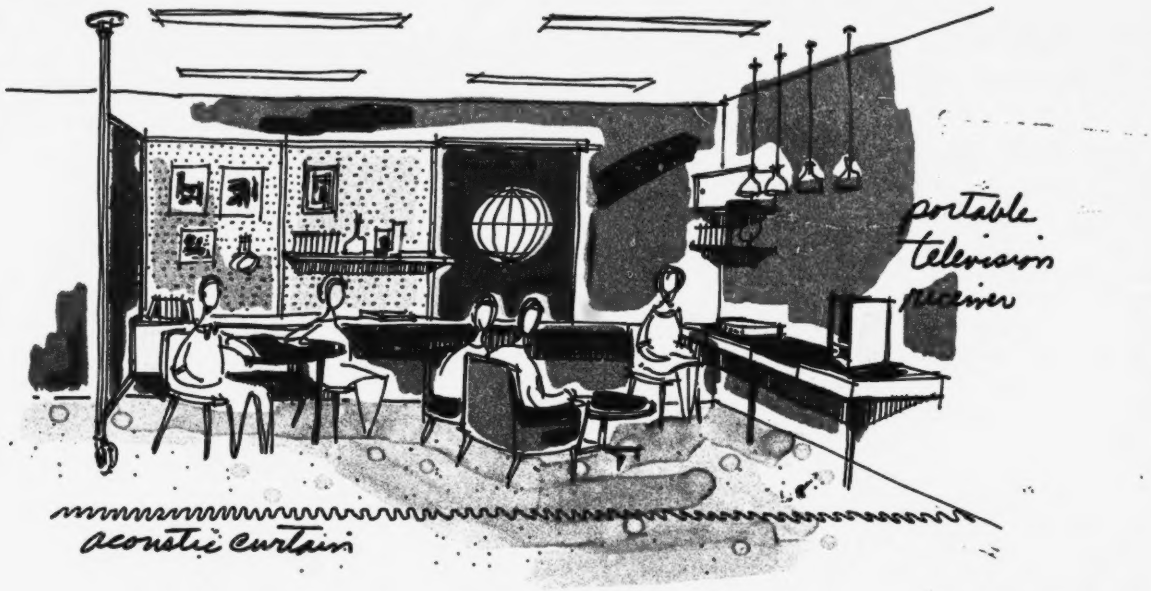


writing surface rotates forward into use position

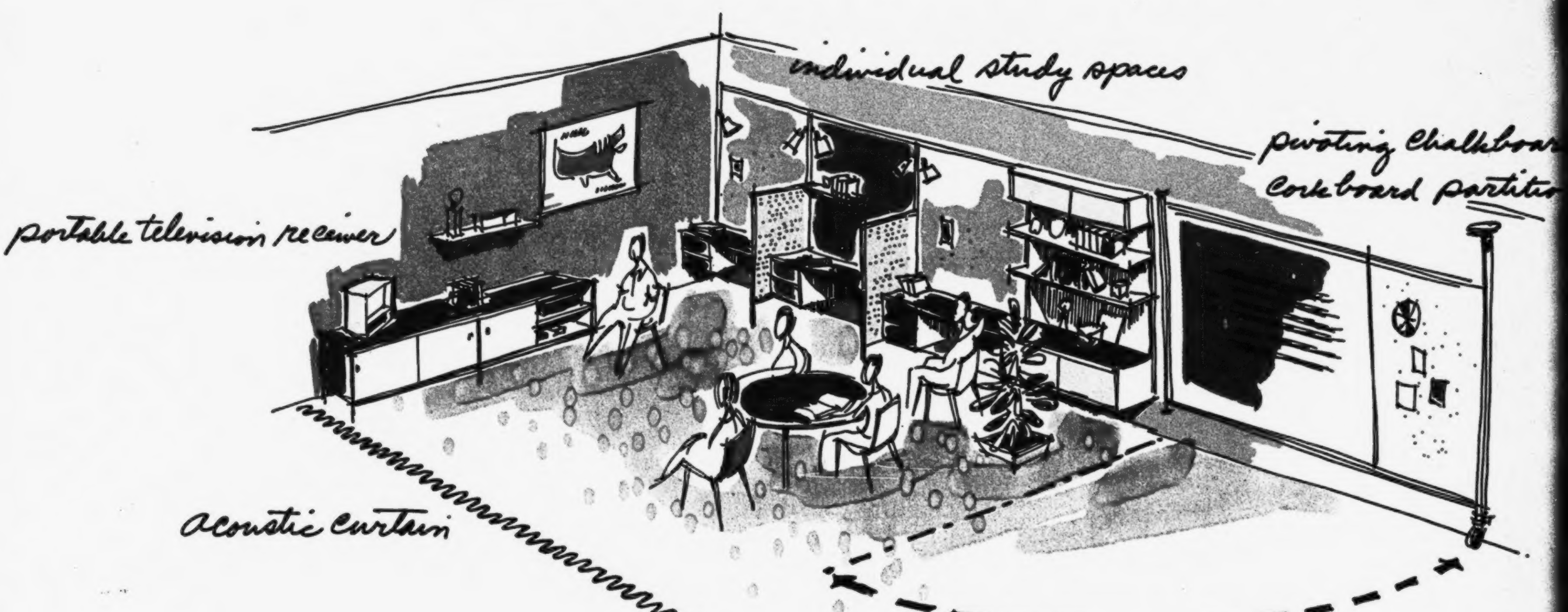


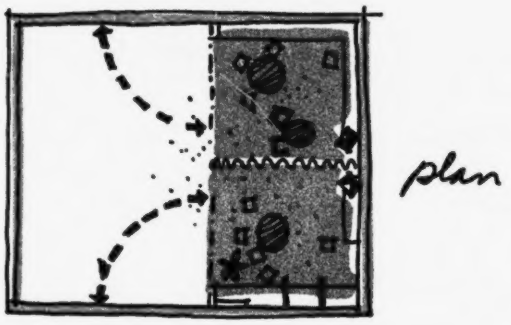
The initial purpose of this study was the preparation of a design report to visualize the spaces within the school of tomorrow, with special emphasis on the question of whether the use of television in education would impose any special design requirements on those spaces. Our answer to that question is *no.* These sketches of school spaces, therefore, are our interpretation of design solutions within the original premise stated at the opening of the report—"*the design of a school, its spaces and its facilities must permit and support the educational function.*" Architecture and structure are properly left to the architect. It is our hope that these sketches may stimulate and spark the imagination of those primarily responsible for the structure and the school plant—the school boards, administrators and teachers. They may wish to use these designs as guides to what is possible if they will clearly formulate their own educational plan for the architect to translate into the specific blueprint for their school of tomorrow.

SEMINAR 2-6 GROUP

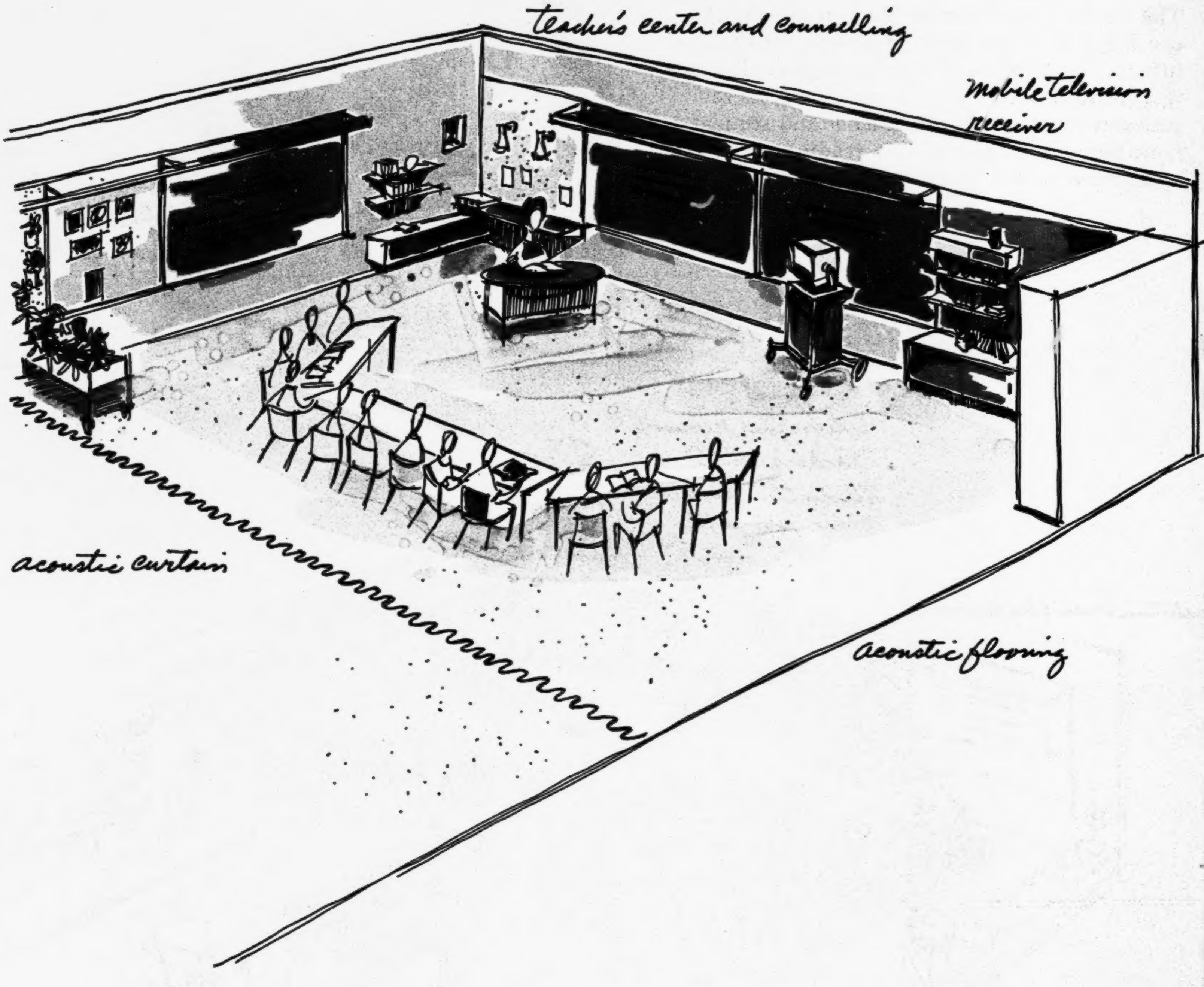

portable television receiver
acoustic curtain

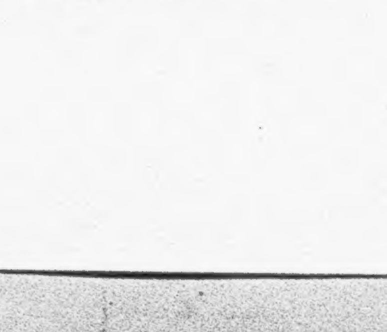
Small seminar size spaces are scaled for small group projects; discussion; individual study and team activity; enrichment television programs for fast learners; repeat television classes for slow learners or makeup sessions. Space is informal, non-institutional, a "study" atmosphere. As shown here, the total area can be expanded and contracted by adjustment of space dividers and partial acoustic drapery to baffle sound between study and discussion groups.


individual study spaces
pivoting chalkboar
corkboard partiti
portable television receiver
acoustic curtain



SEMINAR 12-15 GROUP

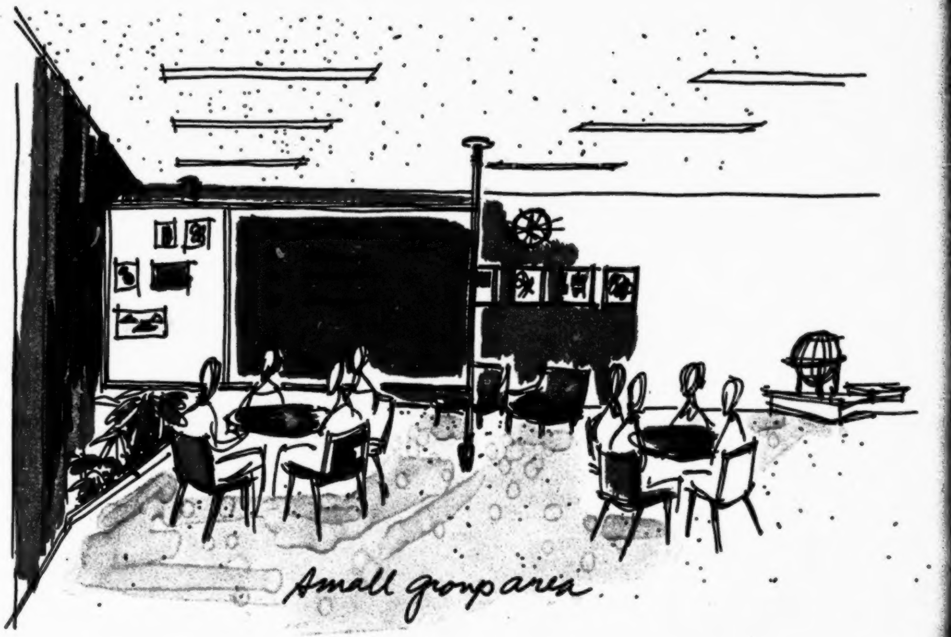

teacher's center and counselling
Mobile television receiver
acoustic curtain
acoustic flooring

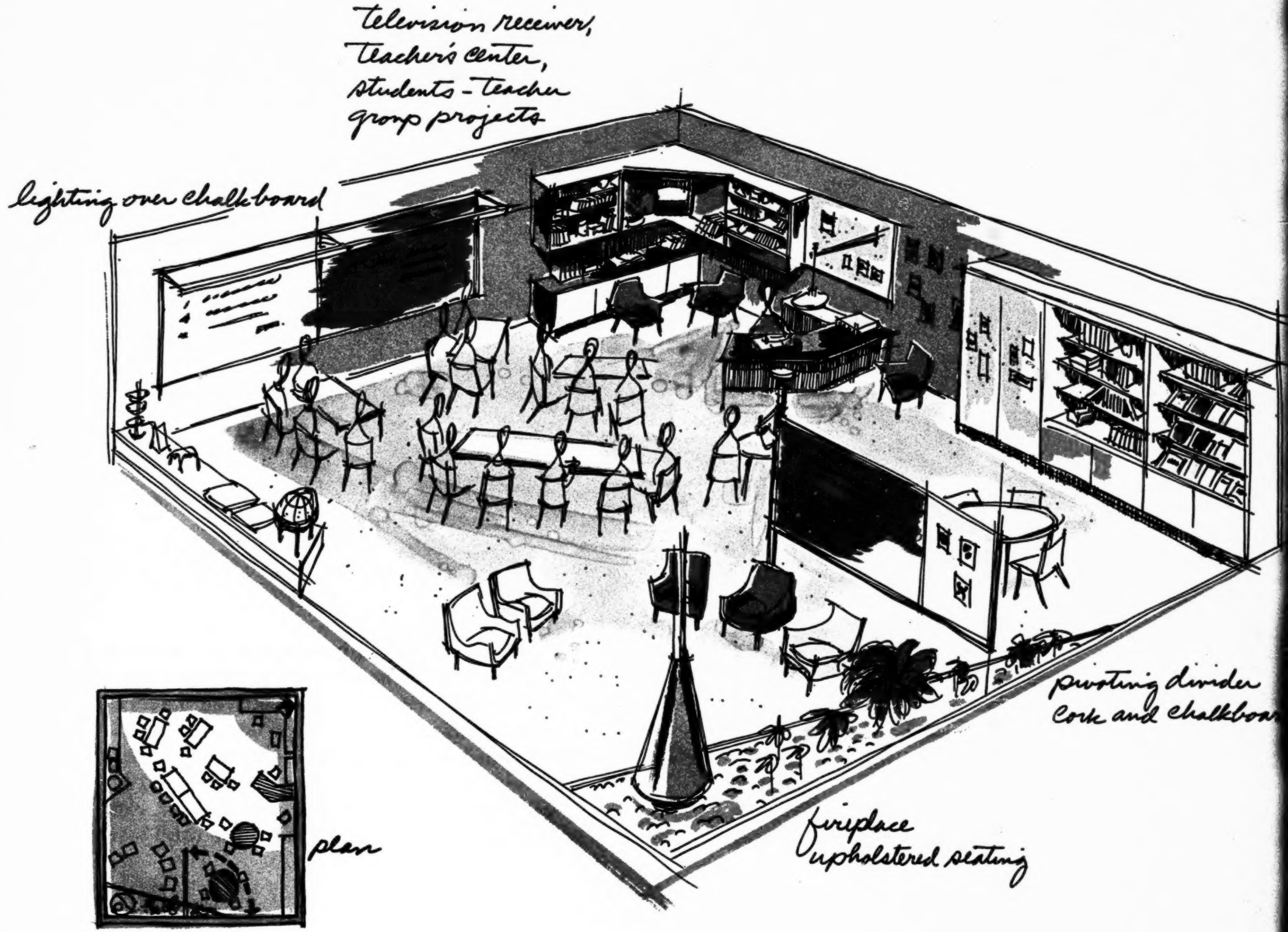


Conference and seminar rooms are more casual, less restrictive than traditional classrooms, encouraging close contact between teacher and students as well as exchange between the students in team-learning sessions. Acoustic curtain divider and movable space divider could provide varying degrees of sound isolation and visual privacy between areas within the total space.

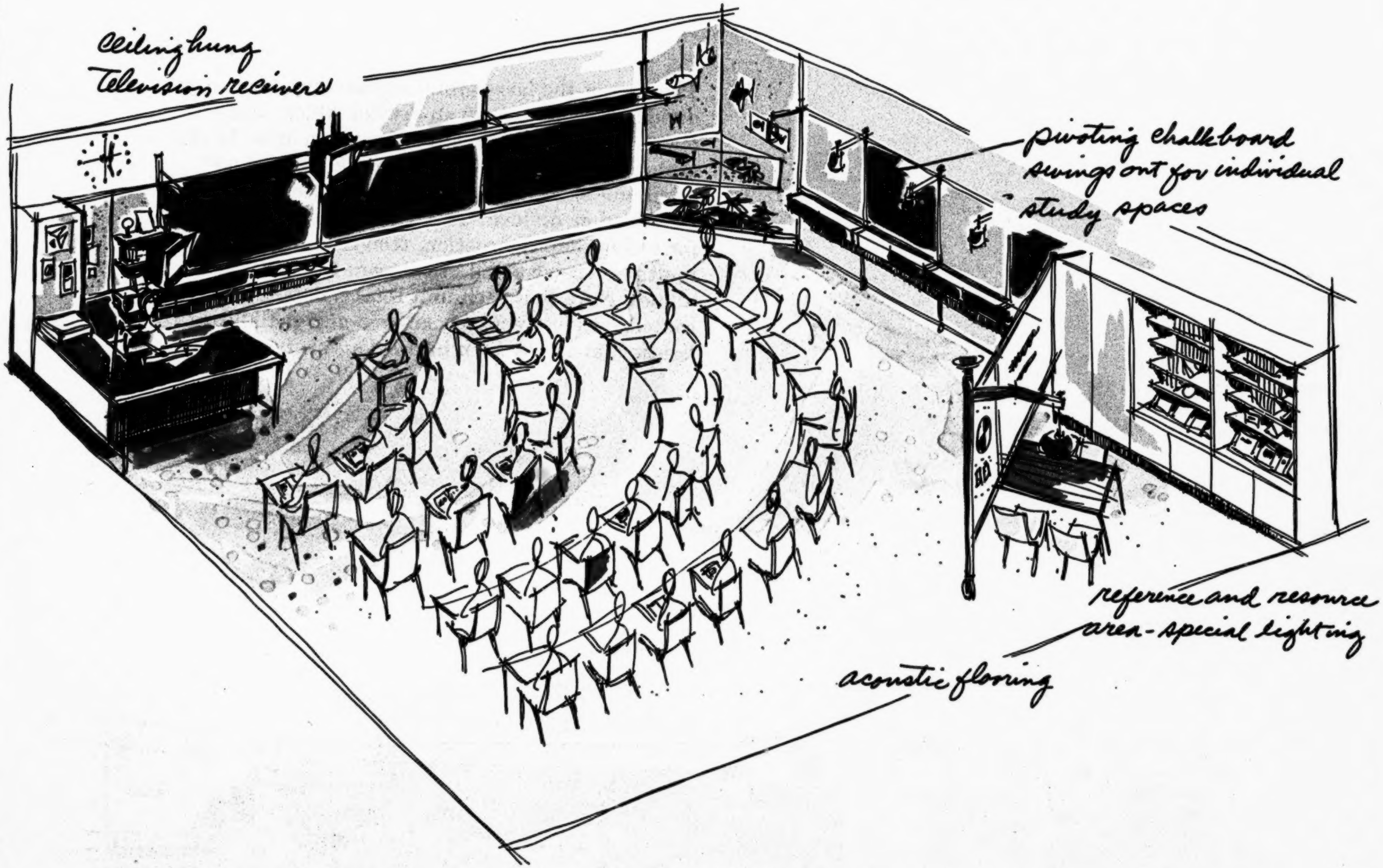
SEMINAR 20-25 GROUP

The smaller classrooms in elementary schools can be planned to better advantage for the future. Creative use of space and space dividers will encourage informal arrangements, more personal contact between teacher and student. Note plan of teacher's center, reading and study area, conversation group arrangement.


Small group area

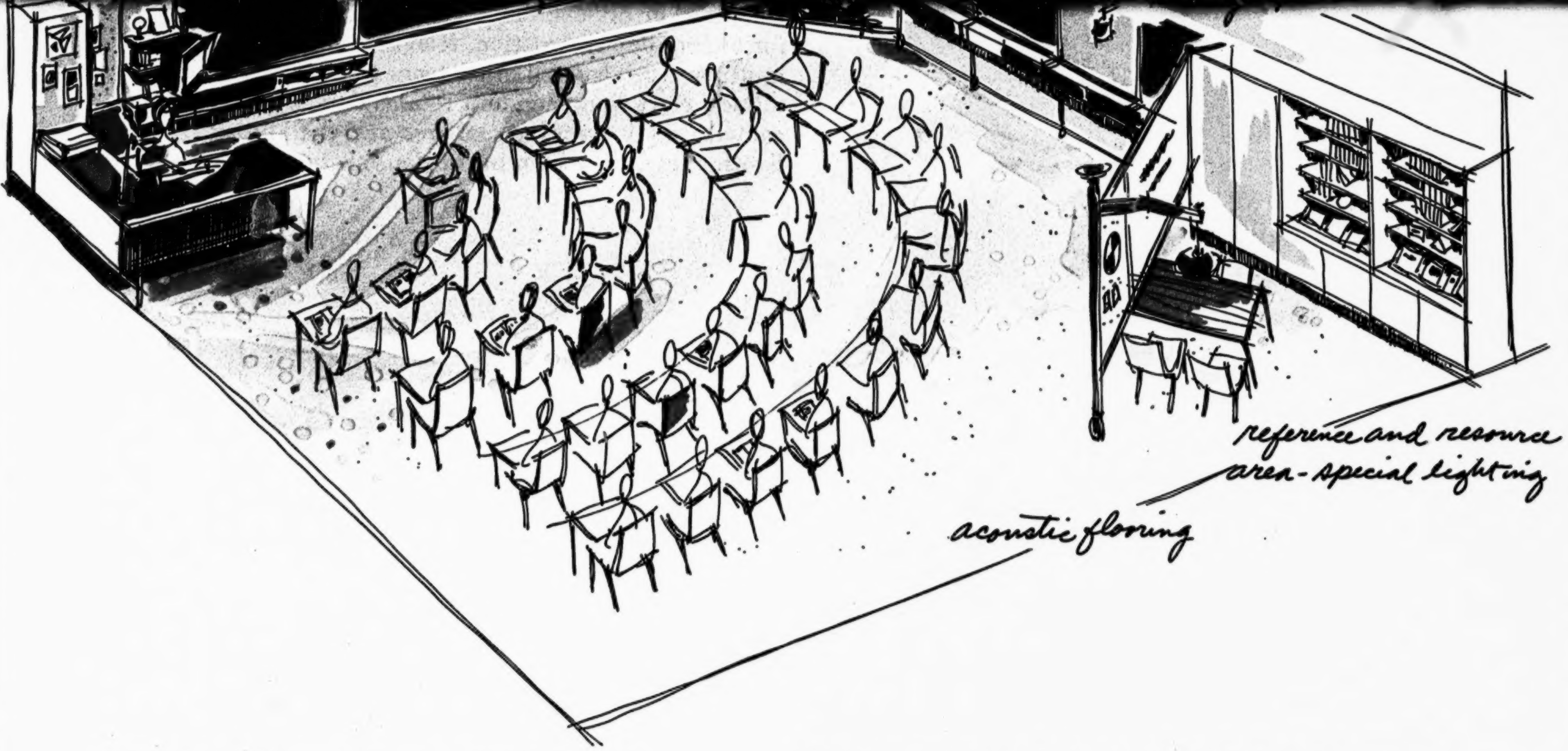

Television receiver,
Teacher's center,
Students - Teacher
group projects
lighting over chalkboard
pivoting divider
Cork and chalkboard
fireplace
upholstered seating
plan

CLASS SPACE 25-40 GROUP


Ceiling hung Television receivers
pivoting chalkboard swings out for individual study spaces
reference and resource area - special lighting
acoustic flooring

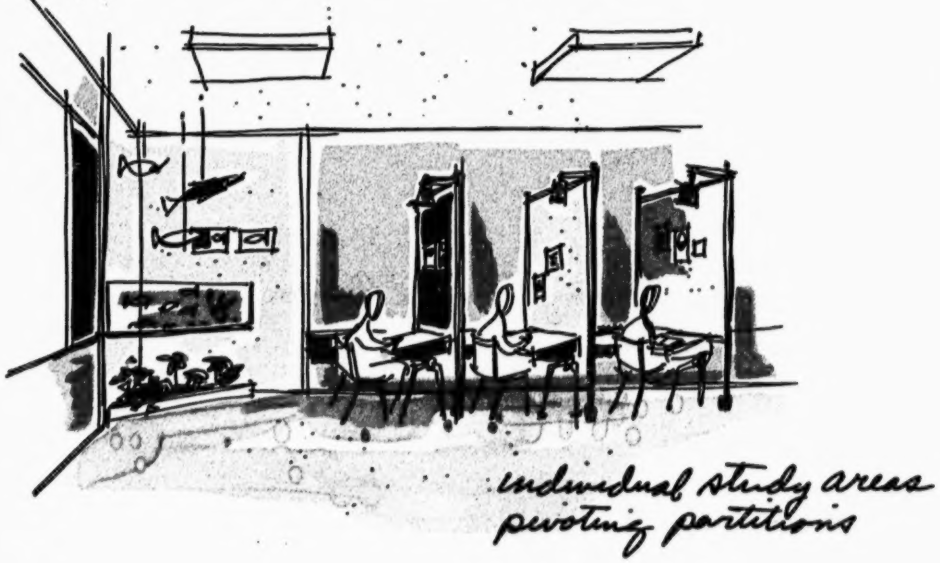
Even the traditional size and shape of today's classrooms with traditional group size will be designed for more effective support of the teaching-learning program in future schools. Note how student seating in the sketch has been re-oriented for improved viewing of demonstrations, television viewing, etc.

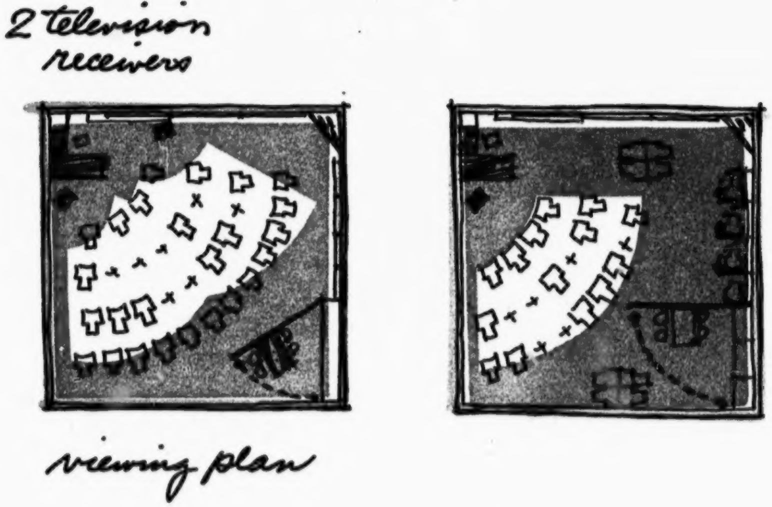
Swing-out carrells at the wall provide individual study areas within the total classroom space. The resources area in one corner offers visual privacy for small group projects or study. Movable furniture allows great flexibility of room arrangements.


reference and resource
area - special lighting
acoustic flooring

Even the traditional size and shape of today's classrooms with traditional group size will be designed for more effective support of the teaching-learning program in future schools. Note how student seating in the sketch has been re-oriented for improved viewing of demonstrations, television viewing, etc.

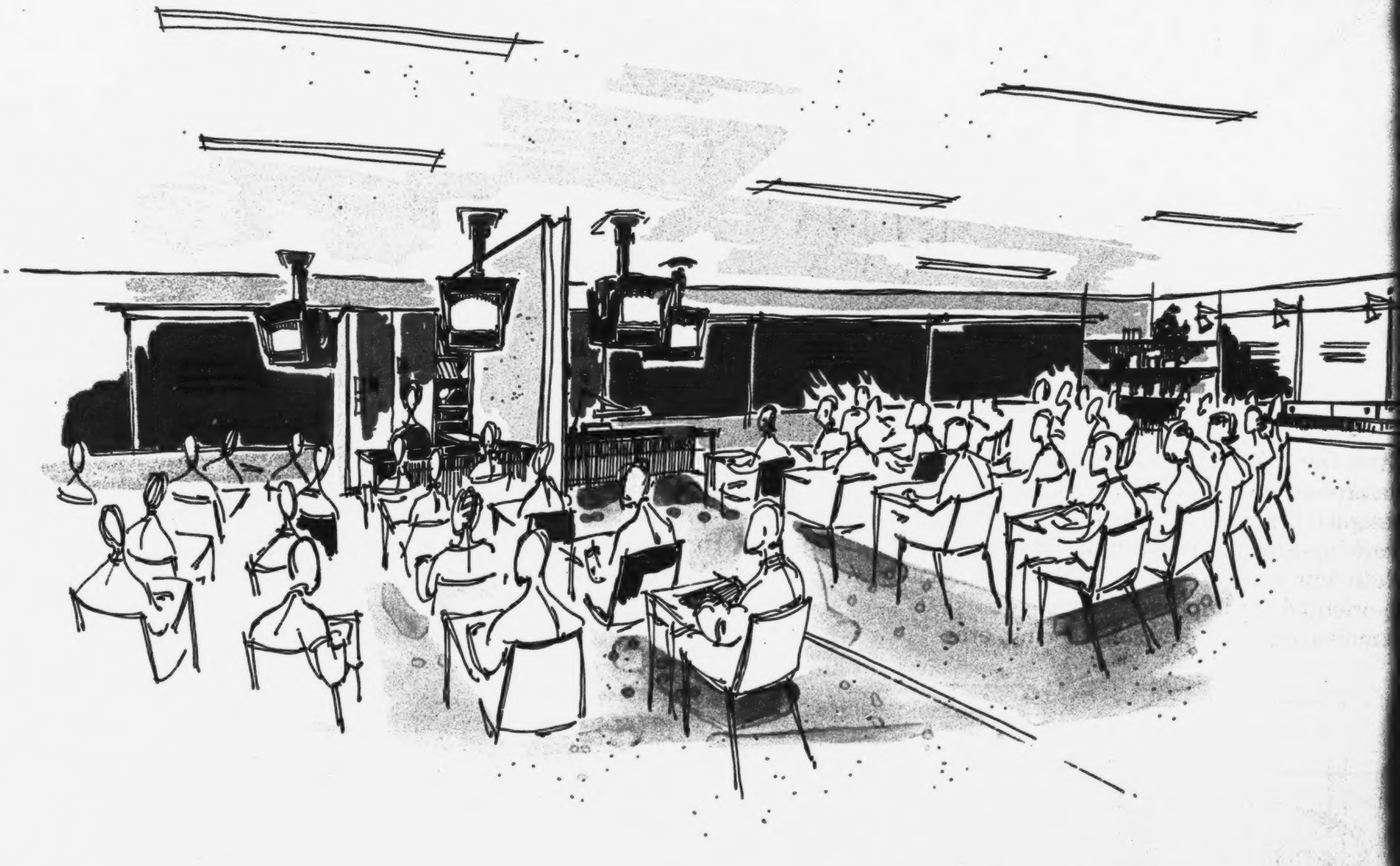
Swing-out carrells at the wall provide individual study areas within the total classroom space. The resources area in one corner offers visual privacy for small group projects or study. Movable furniture allows great flexibility of room arrangements.


individual study areas
pivoting partitions

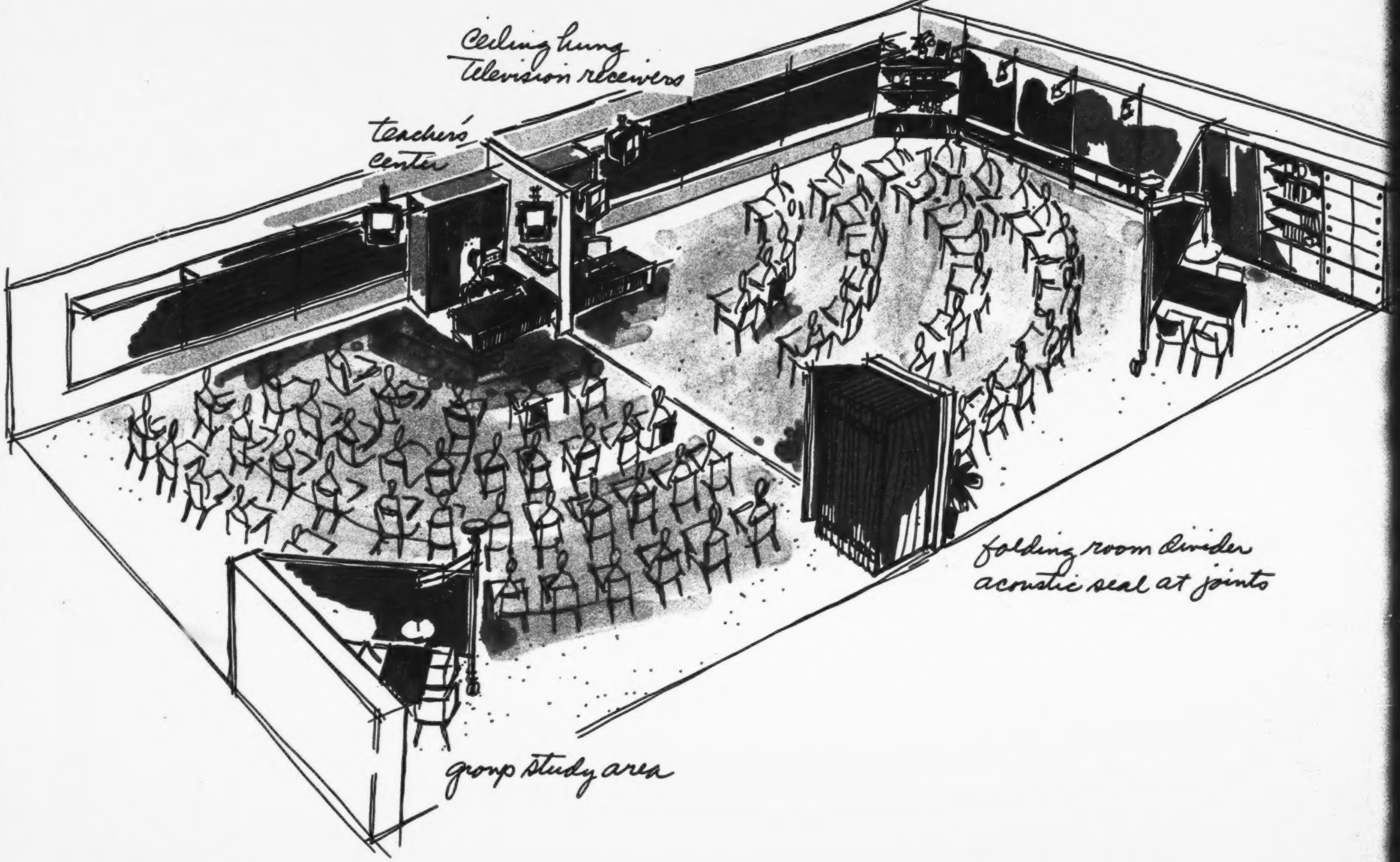

2 television
receivers
viewing plan

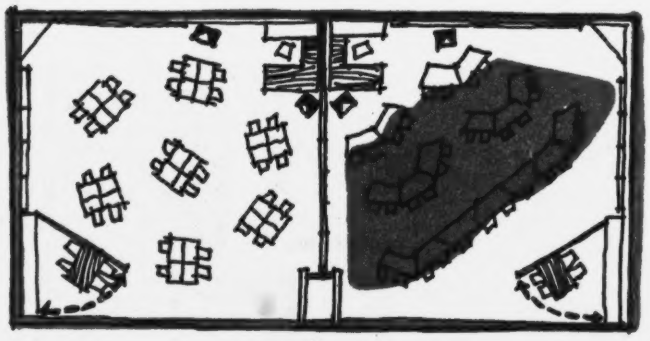
CLASS SPACE 40-60 GROUP

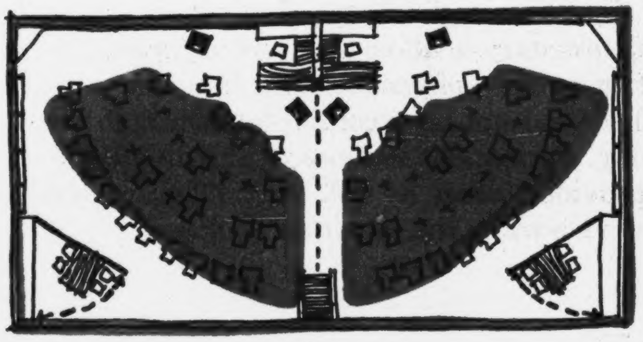
The first of the large group spaces—two classrooms divided by a folding room divider which easily opens to form a single large classroom area. In the sketch the furniture arrangement allows for a minimum of reshuffling when the spaces are combined or divided. This arrangement is suggested for large group instruction, televised instruction with multiple receivers and other team teaching techniques. Note that each unit retains details of resource centers, study areas, special area and chalkboard lighting, etc., as shown in previous sketches.



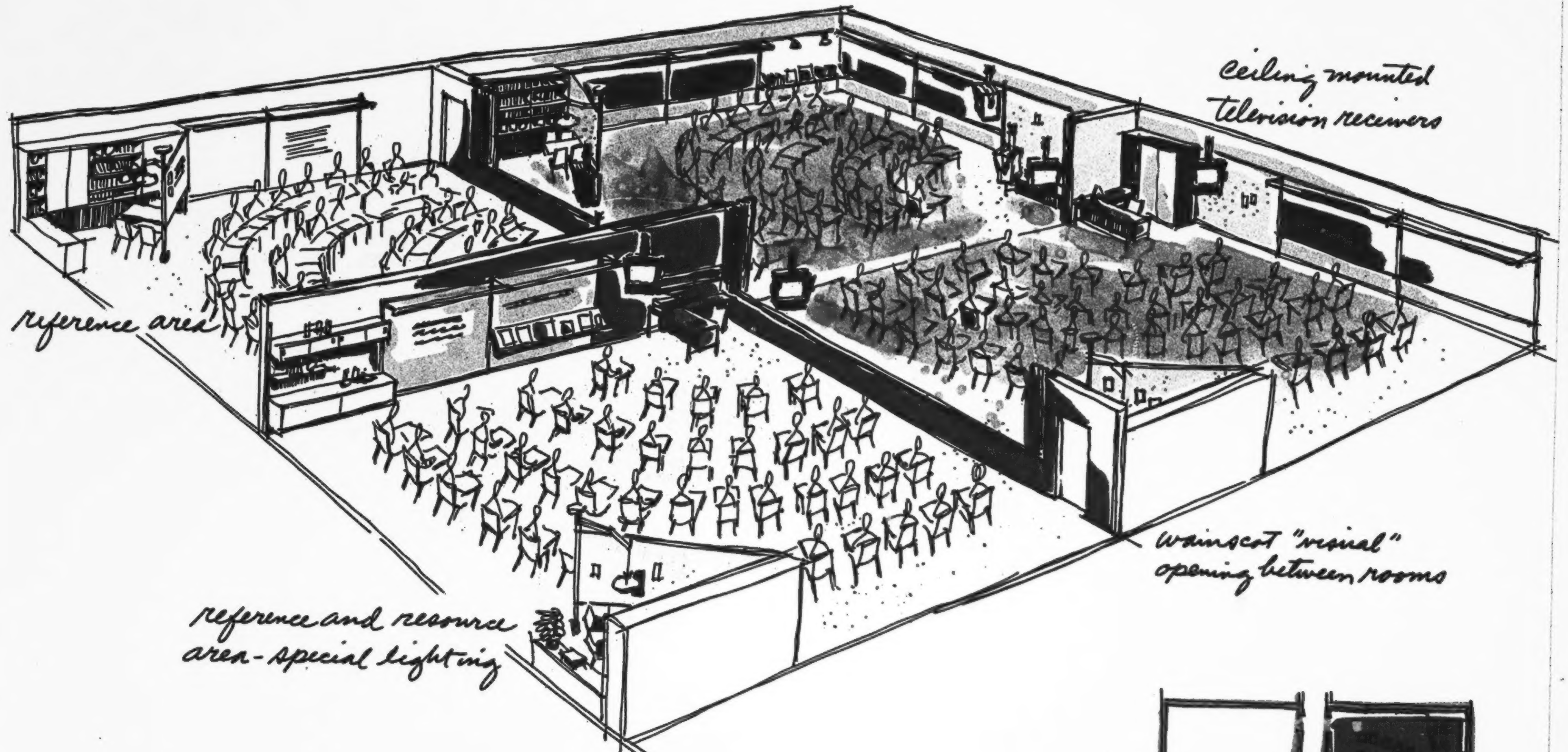
group viewing televised lesson

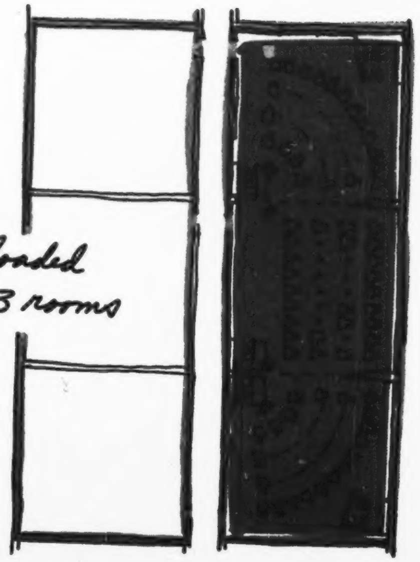

Ceiling hung television receivers
teacher's center
folding room divider acoustic seal at joints
group study area


plan

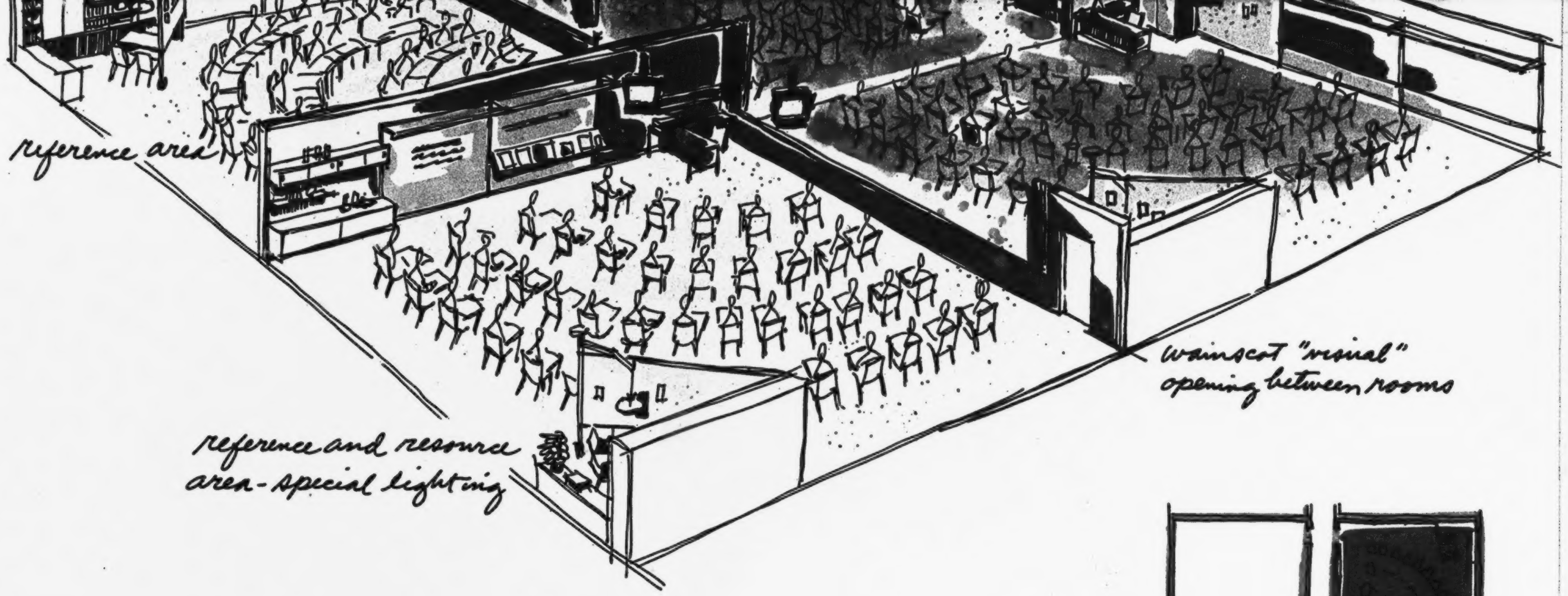

plan

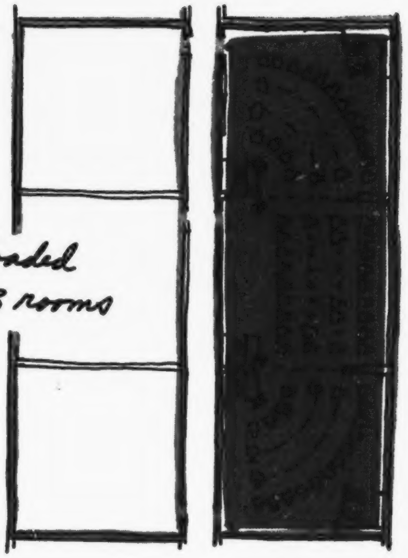
CLASS SPACE 100-200 GROUP

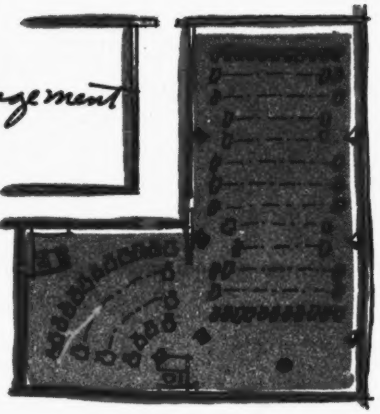

ceiling mounted
television receivers
reference area
wainscot "visual"
opening between rooms
reference and resource
area - special lighting


typical double loaded
arrangement of 3 rooms

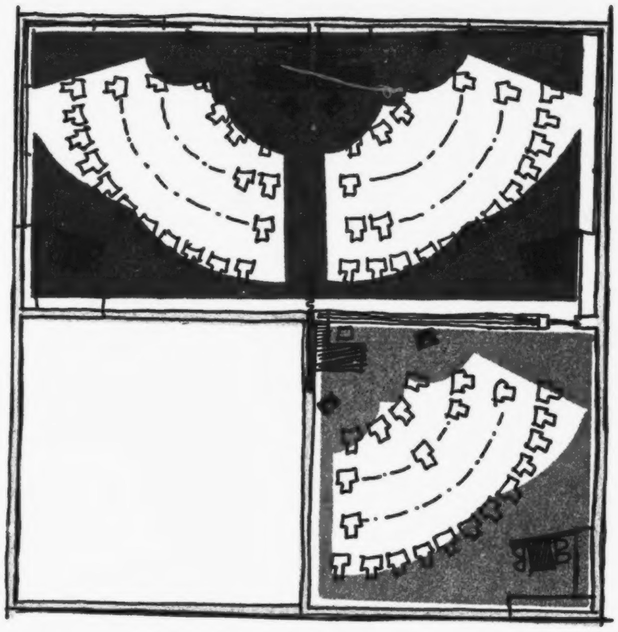
Clusters of classroom units can allow for varying group sizes of 30-60-90-120-150-etc. The sketches illustrate two types of operable partitions—ceiling-to-floor and wainscot-height. The latter partition, beginning at desk height, recognizes the fact that *clear sight lines and passage of sound are often all that is necessary to allow two learning groups to*


reference area
reference and resource area - special lighting
wainscot "visual" opening between rooms

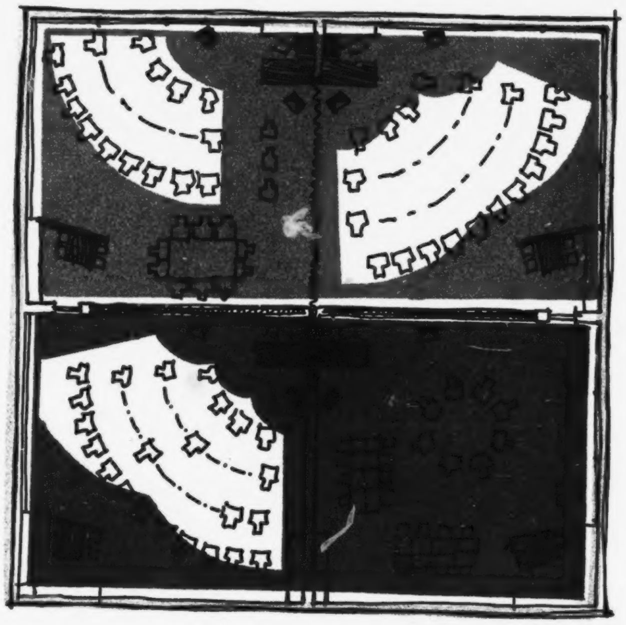

typical double loaded arrangement of 3 rooms


end of wing arrangement

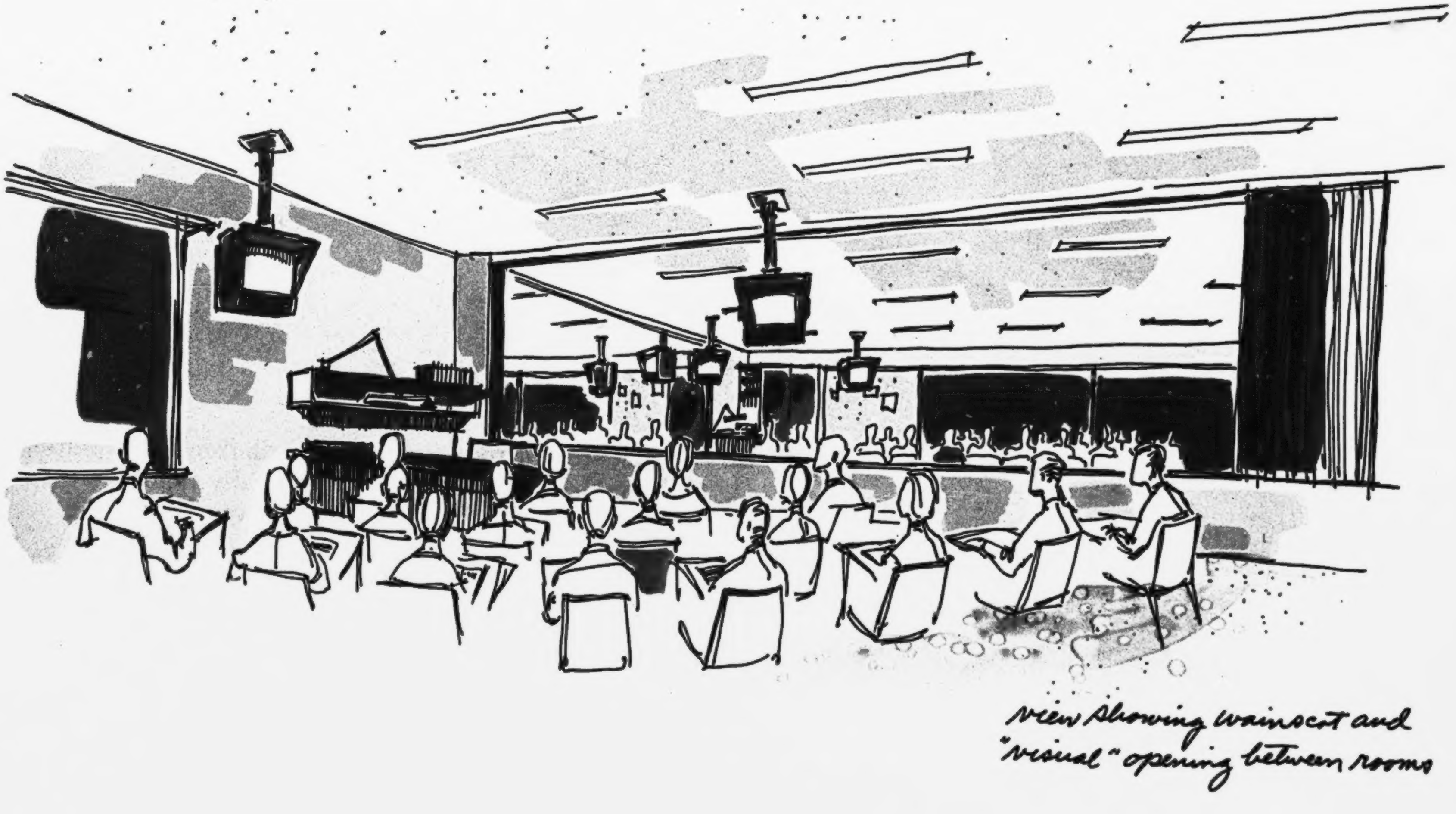
Clusters of classroom units can allow for varying group sizes of 30-60-90-120-150-etc. The sketches illustrate two types of operable partitions—ceiling-to-floor and wainscot-height. The latter partition, beginning at desk height, recognizes the fact that *clear sight lines and passage of sound are often all that is necessary to allow two learning groups to function as one*—physical access from one area to another need not be accomplished through the opening. Permanent sections of the dividing wall can provide storage as well as an effective acoustic seal device when the partition is closed.



three group plan

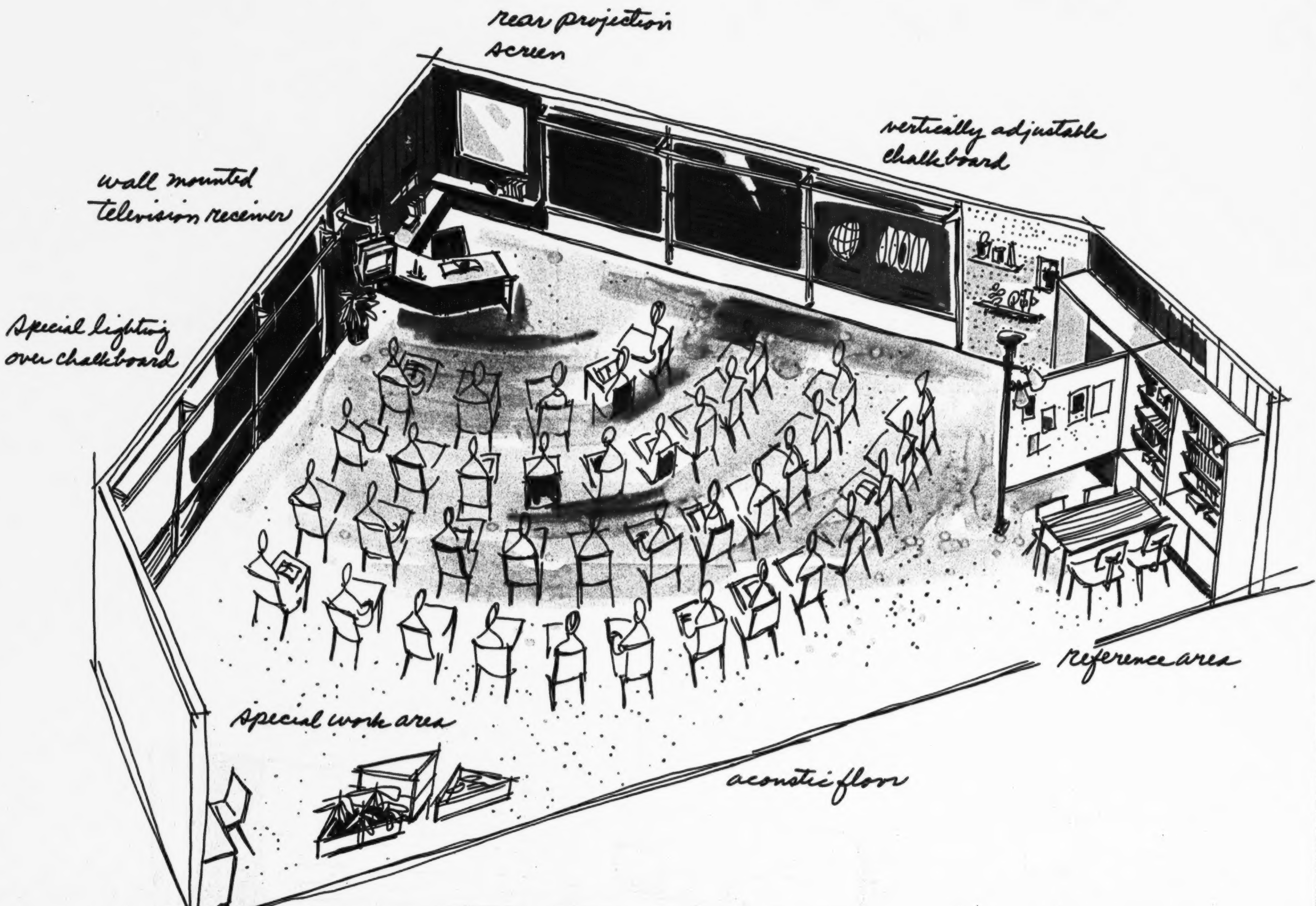


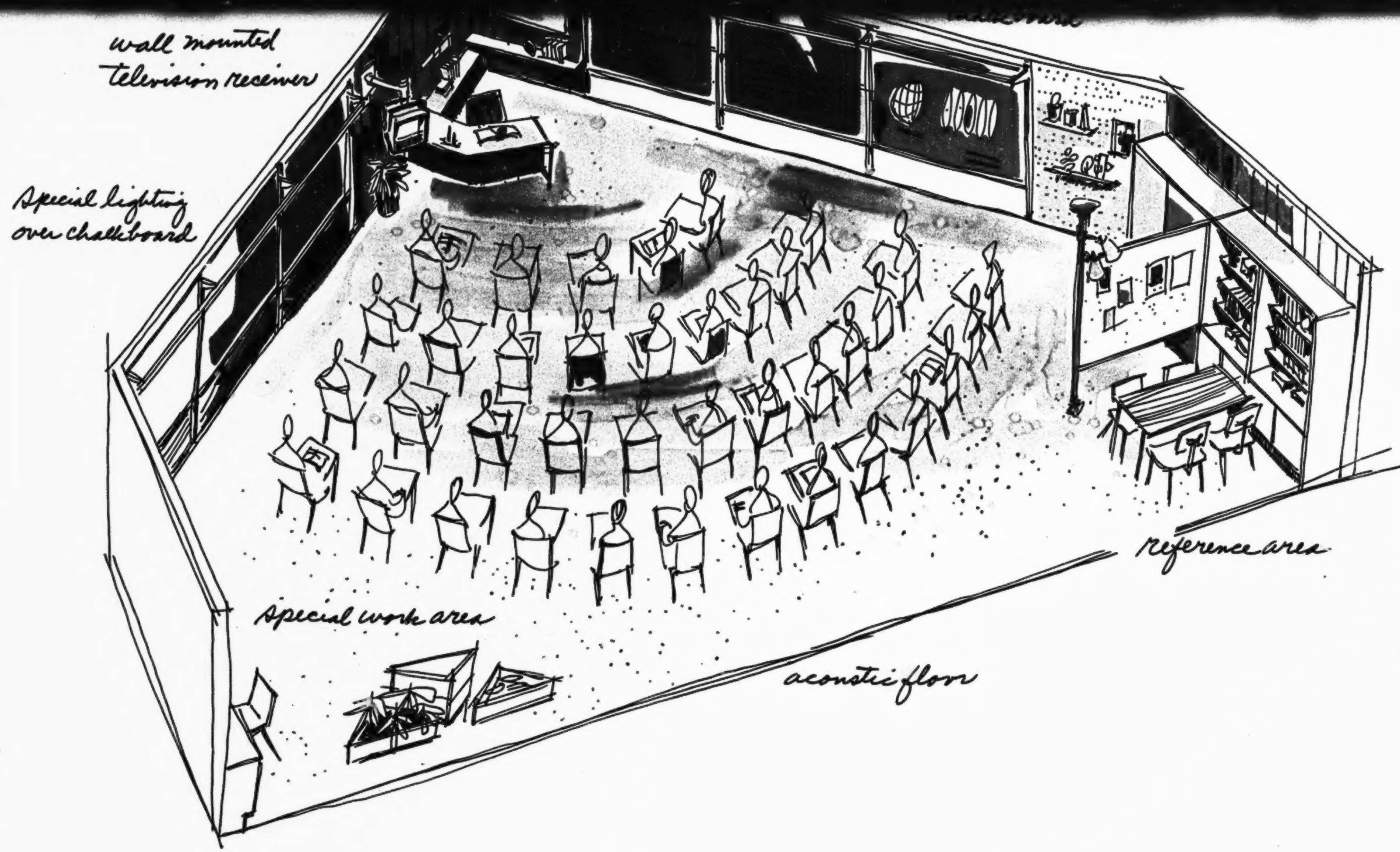
four group plan



view showing wainscot and "visual" opening between rooms

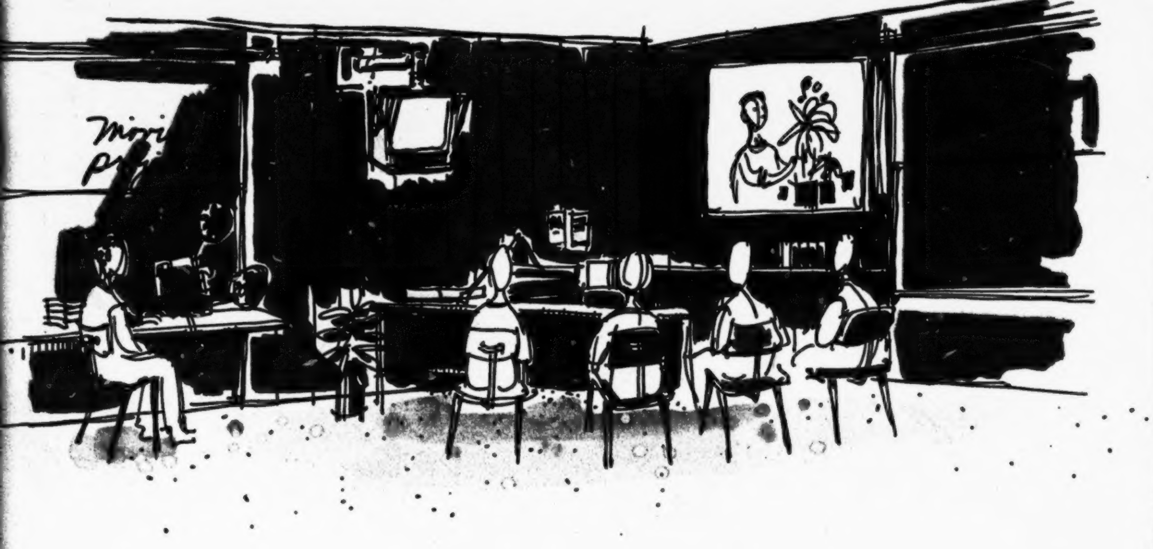
CLASS SPACE 25-35 GROUP

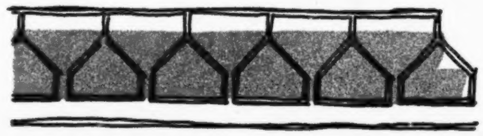

rear projection screen
vertically adjustable chalkboard
wall mounted television receiver
Special lighting over chalkboard
Reference area
Special work area
acoustic floor


wall mounted television receiver
Special lighting over chalkboard
Special work area
acoustic floor
reference area

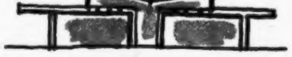
Classrooms and spaces that break from the traditional box shape can be better acoustically than the rectangle and also serve the purpose of variable group arrangements to advantage. Whether for a smaller seminar space or a traditional classroom group of 25-35 students as shown in the sketches, the triangular space can effectively employ space dividers for reading and reference areas. The teacher's center is at the natural point of focus where television and projection screen are also located within the 90° arc of the student's viewing angle.

rear projection viewing

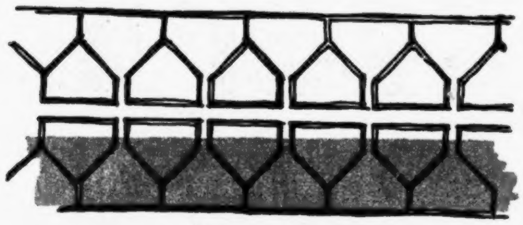




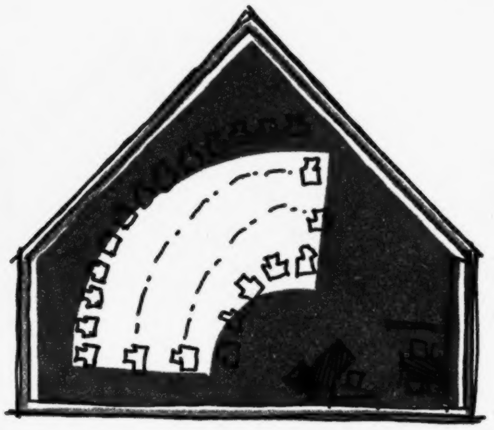
typical single loaded corridor



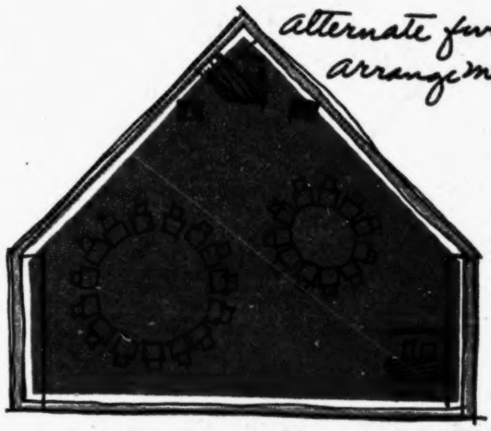
section



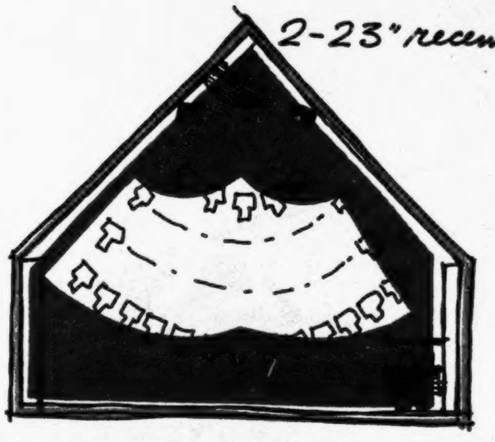
typical double loaded corridor



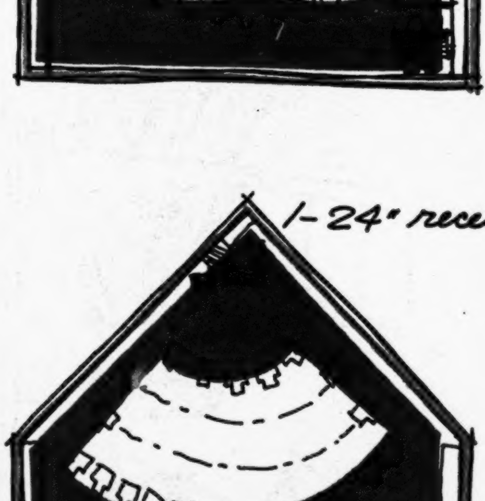
alternate furniture arrangement



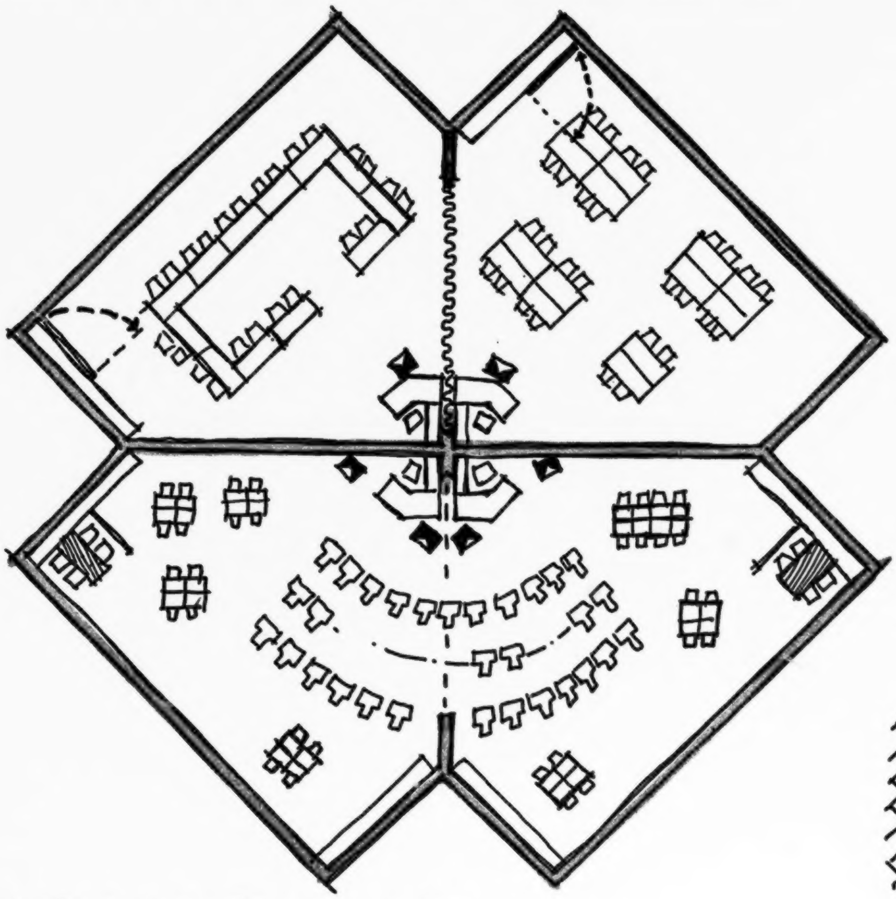
2-23" receivers plan



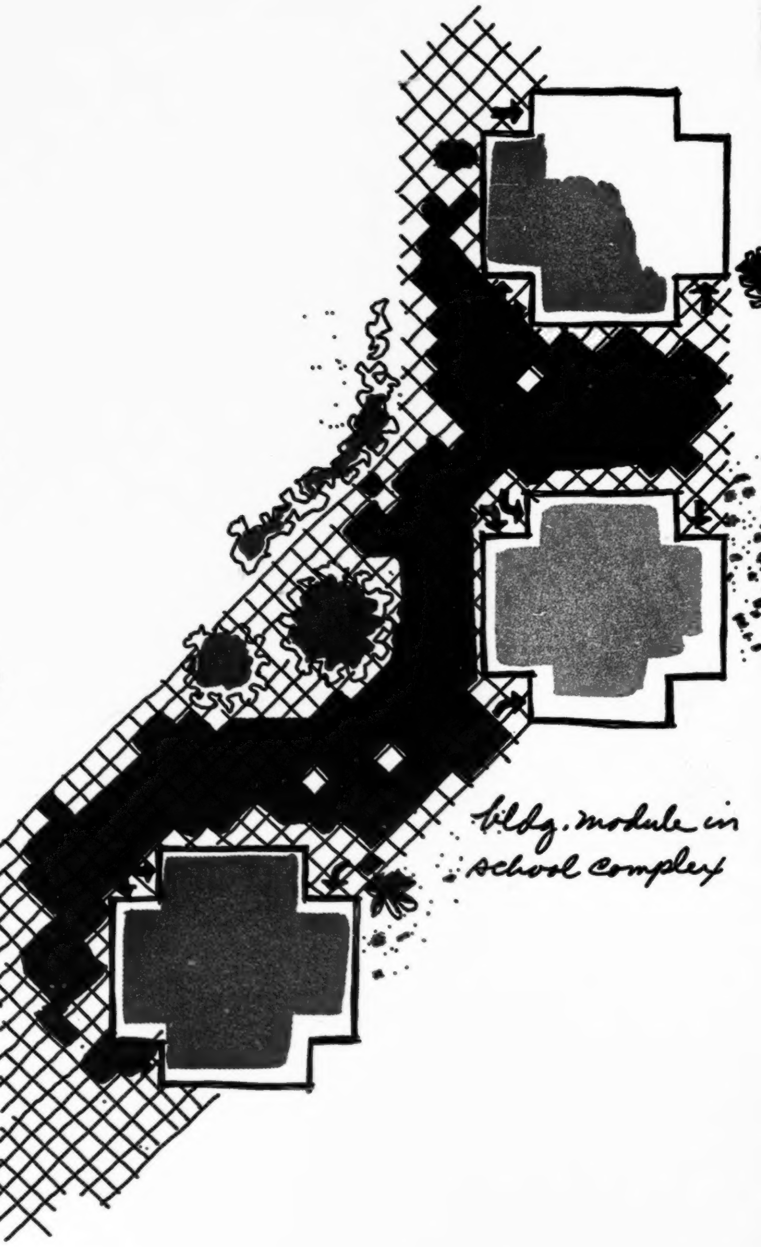
1-24" receiver plan



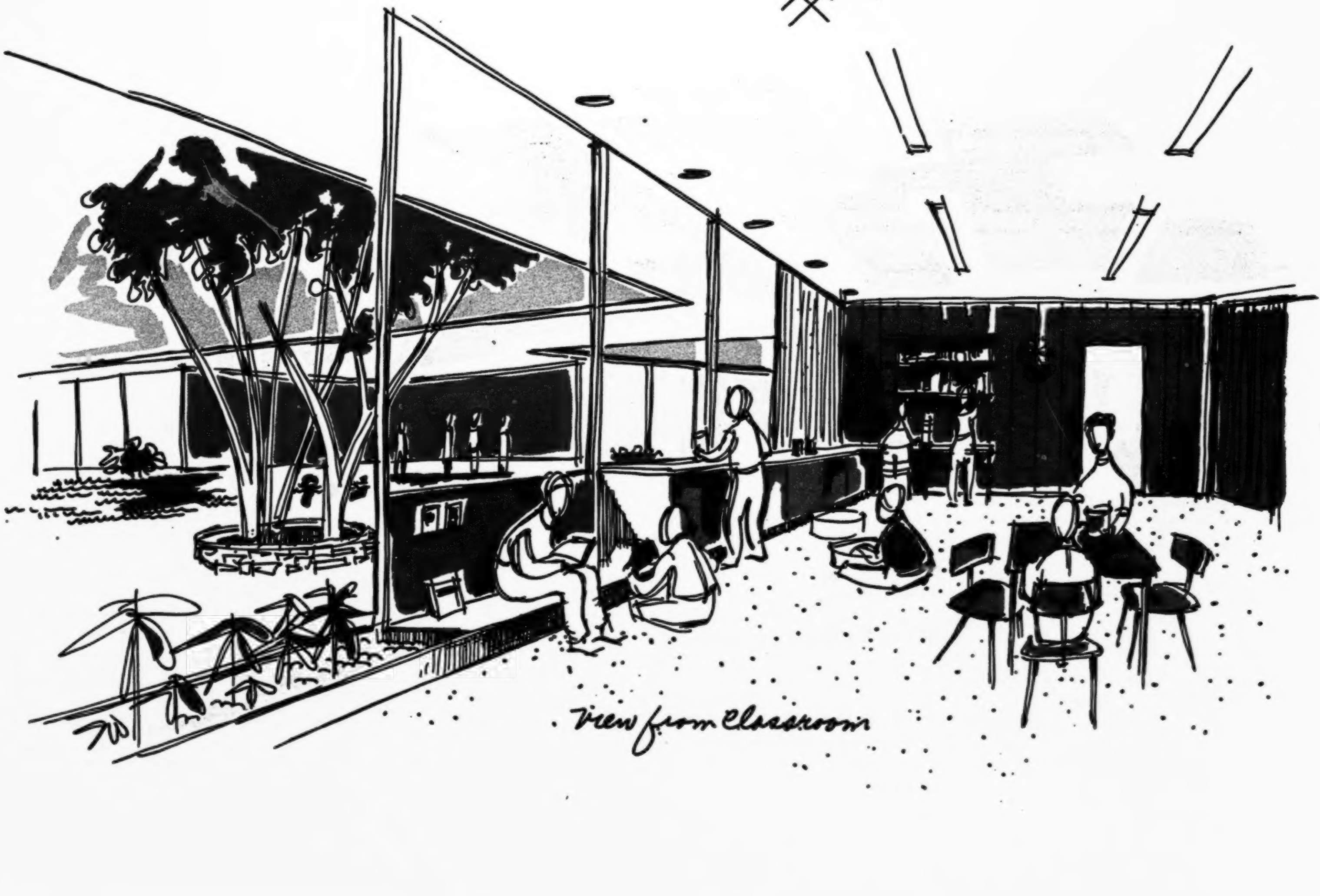
CLASS SPACE 40-60 GROUP



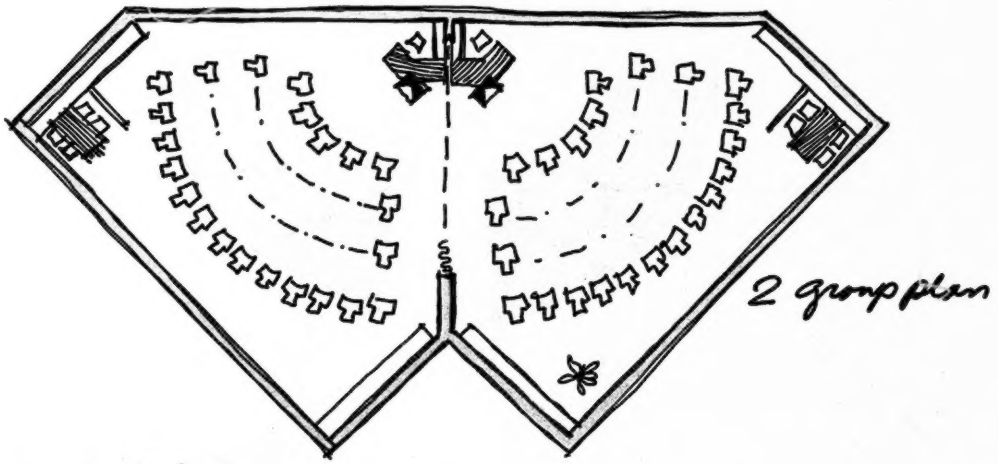
Combination of 2-two group units to form a modular building unit

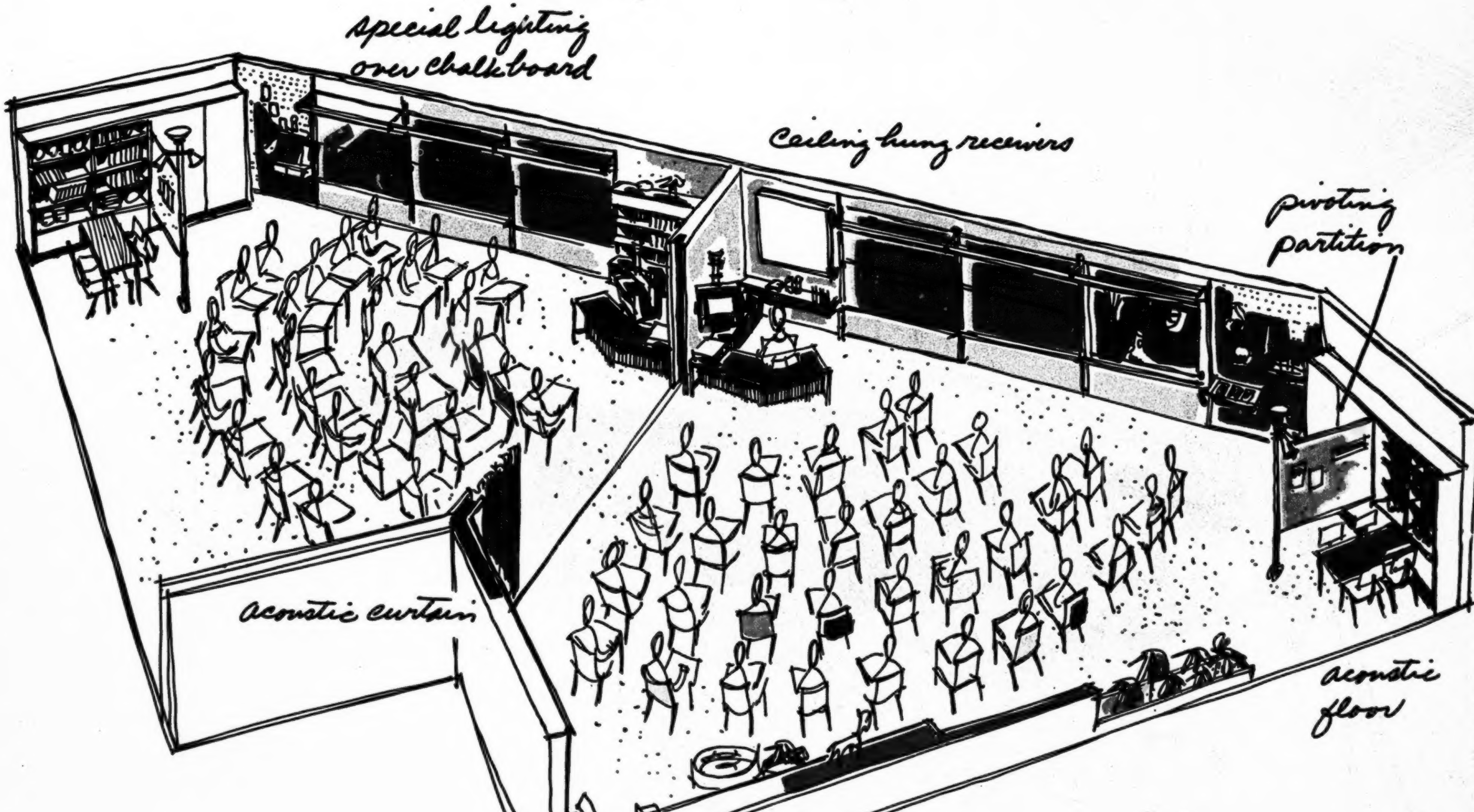


bldg. module in school complex



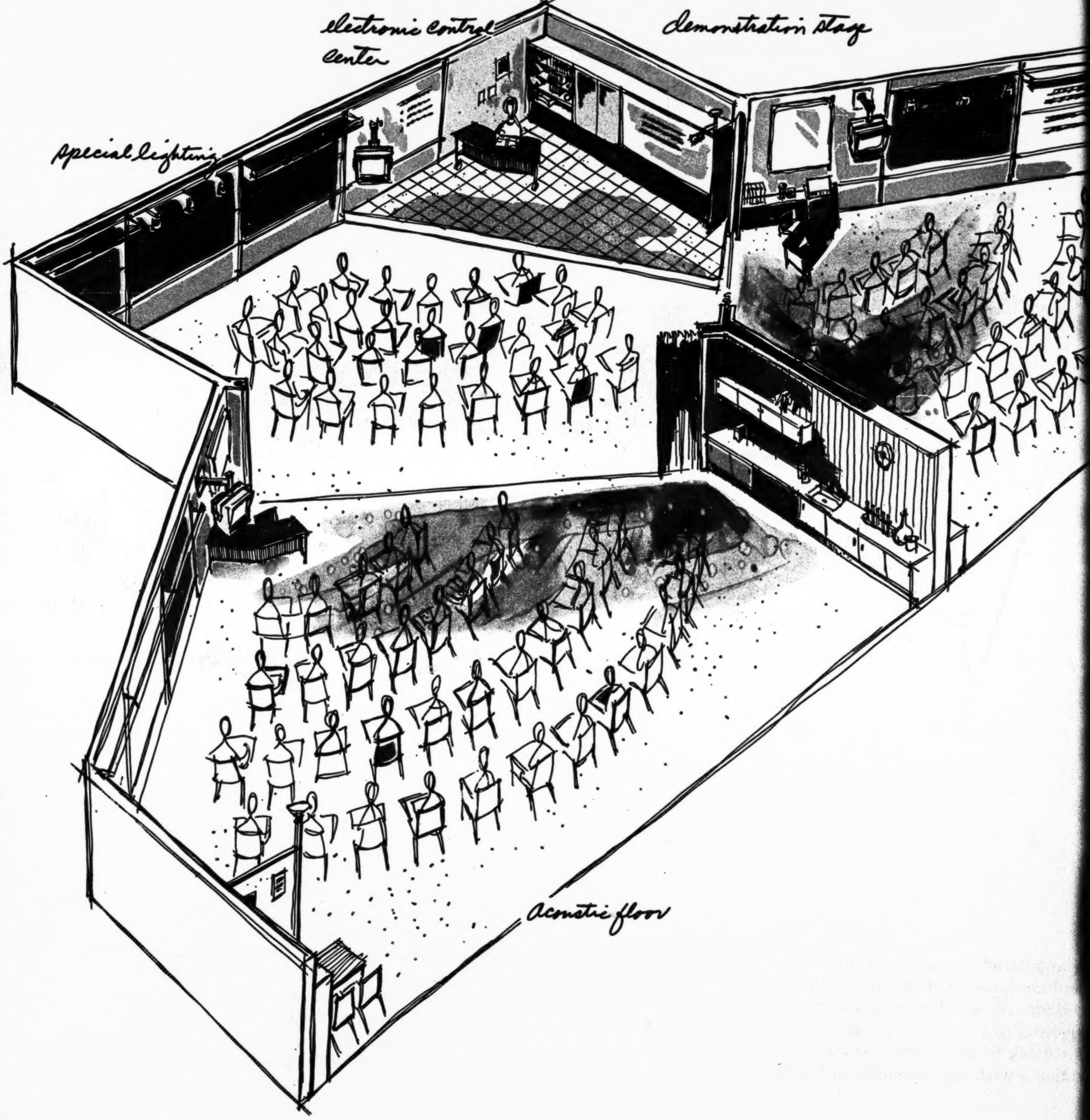
View from Classroom

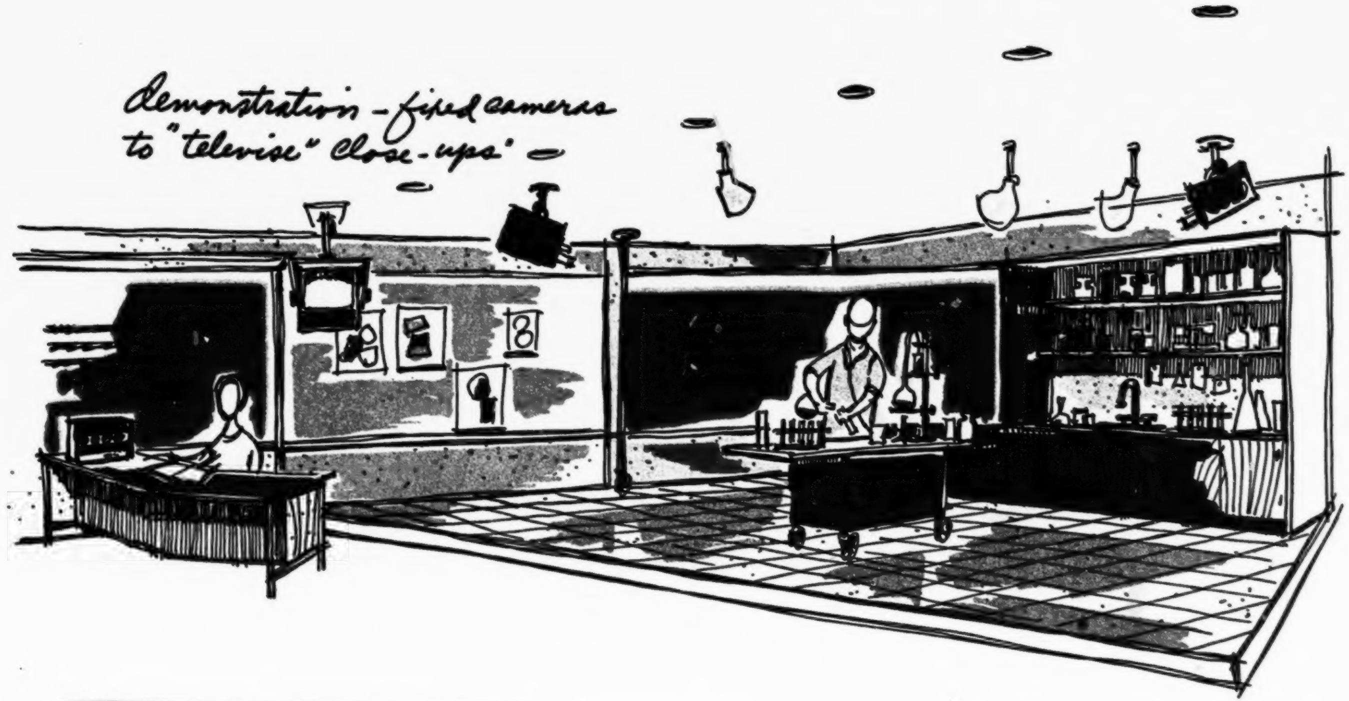

2 group plan


special lighting over chalkboard
Ceiling hung receivers
pivoting partition
acoustic curtain
acoustic floor

Triangulated shapes work effectively together in combinations for larger group sections of 40 or more students. When the combined area is opened for a televised instructional course or lecture, one teacher can speak to or supervise the full complement of students with ease. Acoustical treatment of the floors by carpeting is a major step toward reducing the distracting sounds that originate in the area through the movement of furniture, dropping of books and pencils, etc. Soft floor coverings along with furnishings, color and irregular room shape work together to break from institutional visual effects.

CLASS SPACE 90-120 GROUP


electronic control center
Demonstration stage
Special lighting
Acoustic floor



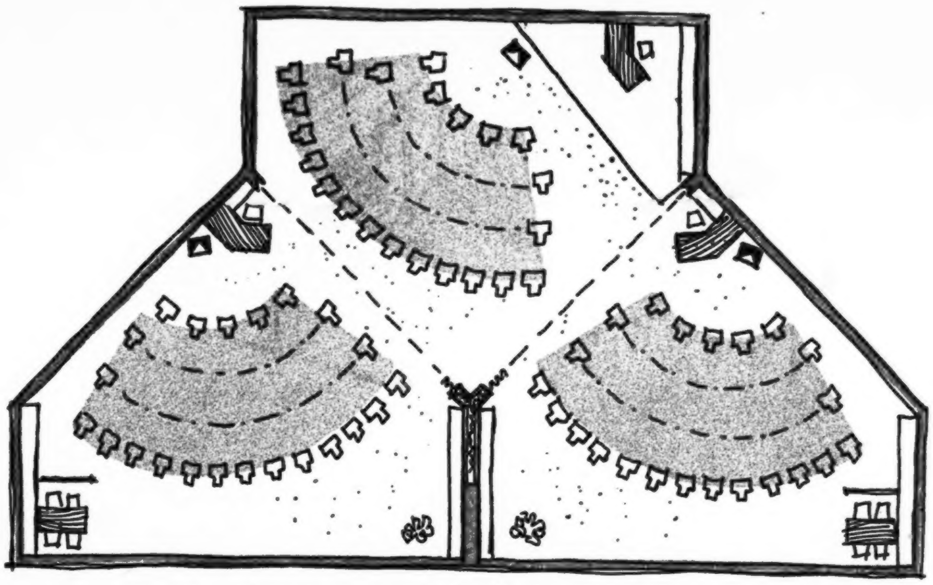
Demonstration - fixed cameras to "televise" close-ups -

When more than two spaces are adjacent and equipped with operable dividers, there is opportunity to design the focal unit with special demonstration area equipment, lighting, etc.

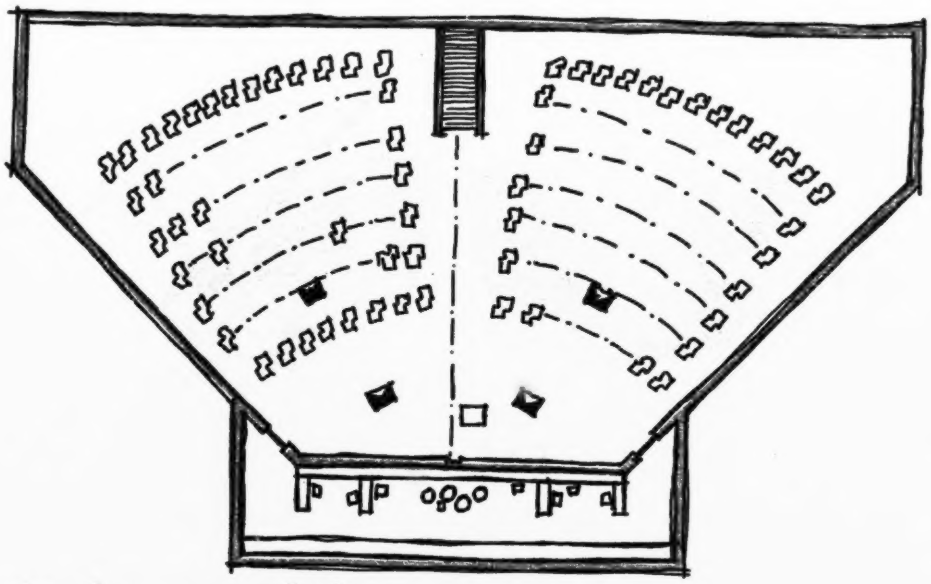
The sketch of this large group lecture or television space for 90-120 students includes fixed television cameras for broadcasting "close-ups" of demonstration details through the receivers located for proper viewing by each section of students. By virtue of the televised portion of the demonstration, the student is closer to the experiment or display than he could possibly be unless instruction were completely individualized.

As these total spaces grow larger, placement of the audio speakers, balance between speakers and reverberation time must be more carefully controlled for audio intelligibility.

There are available today "wireless" microphones that can be carried on the person, that would be useful in such large group situations. They are currently too expensive for ordinary educational use but should become more economical in the next few years.

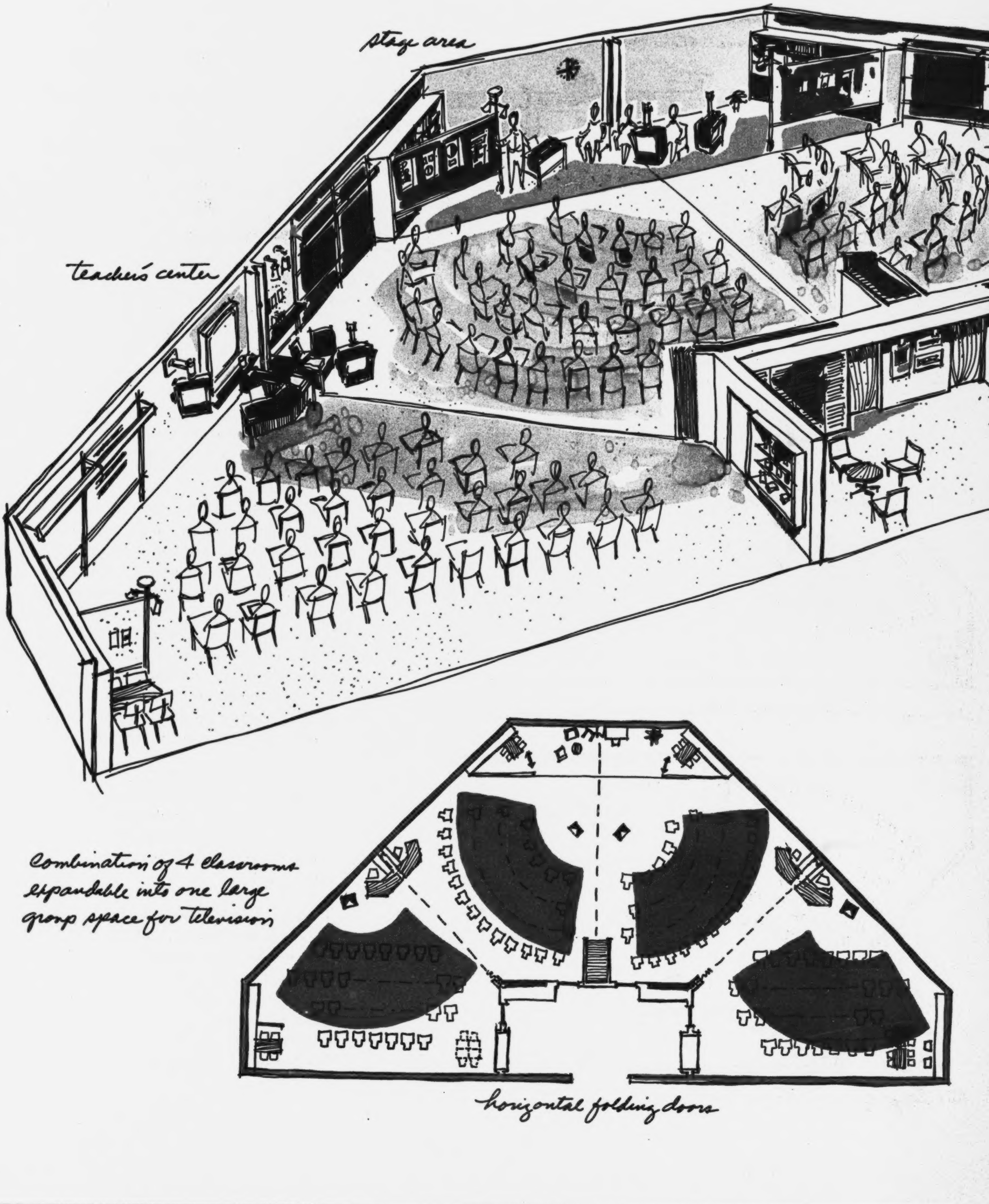


arranged for large group television class

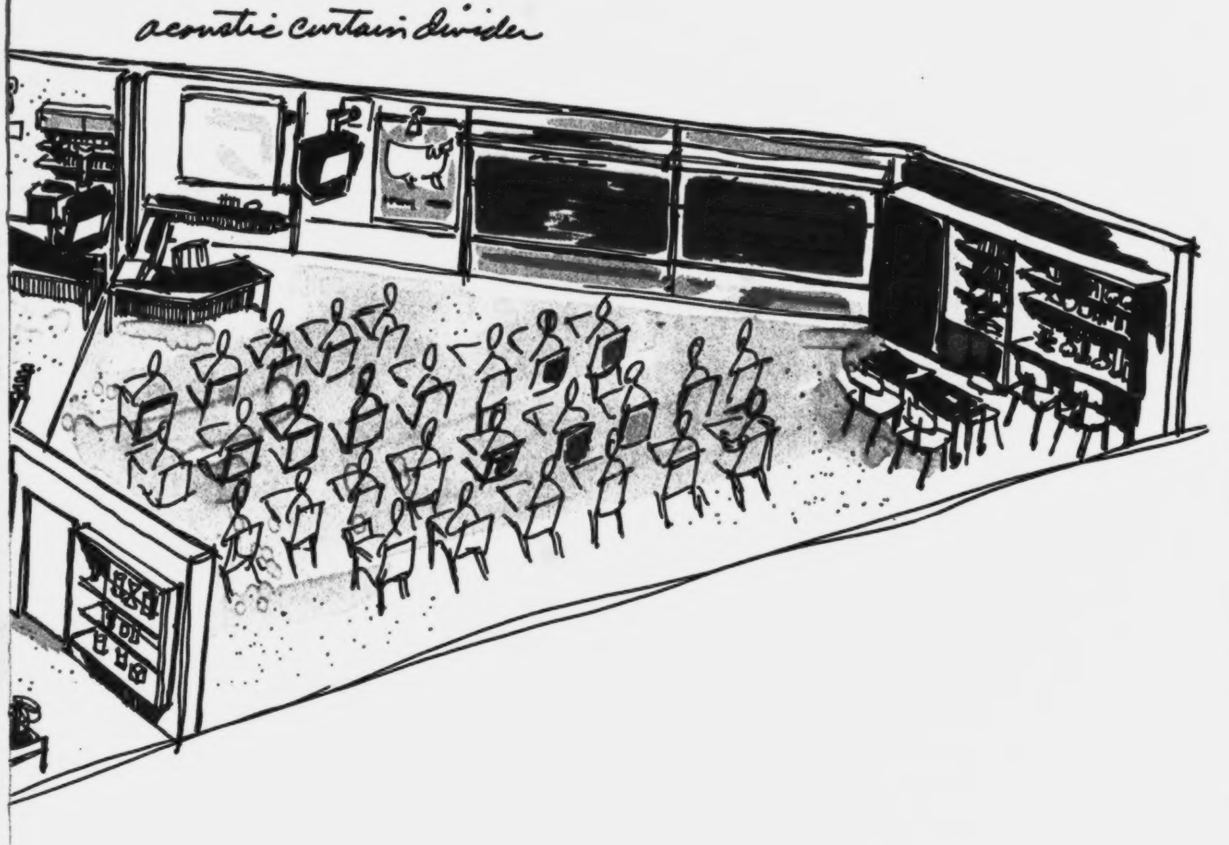


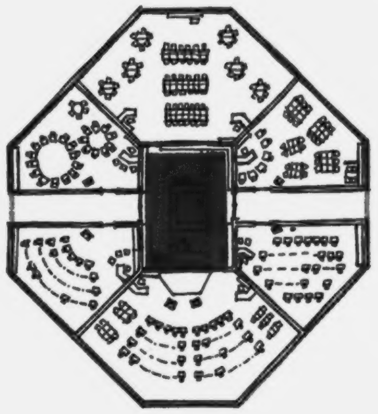
two large group lecture spaces

CLASS SPACE 100-200 GROUP

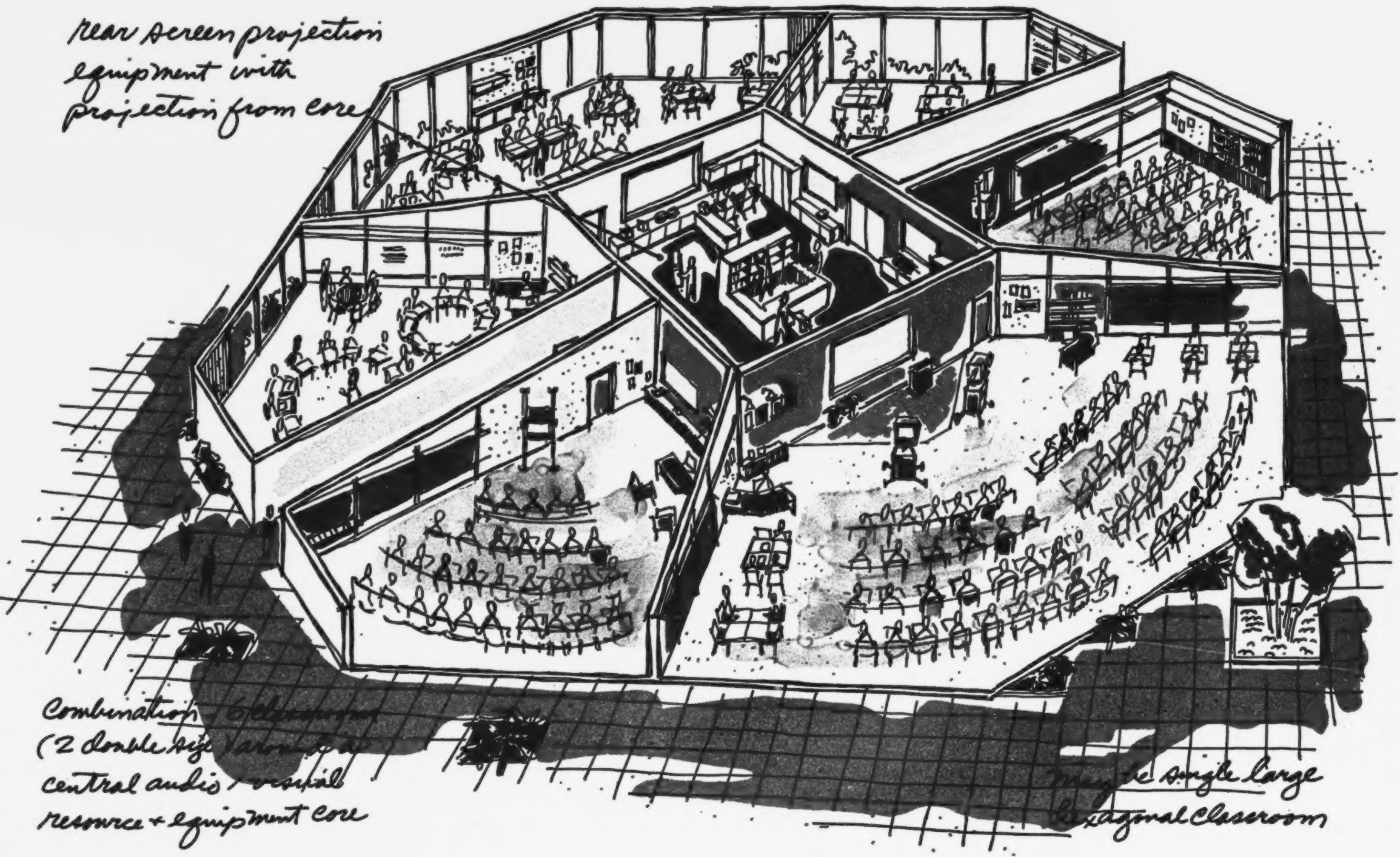

stage area
teacher's center
horizontal folding doors

Combination of 4 classrooms expandable into one large group space for television

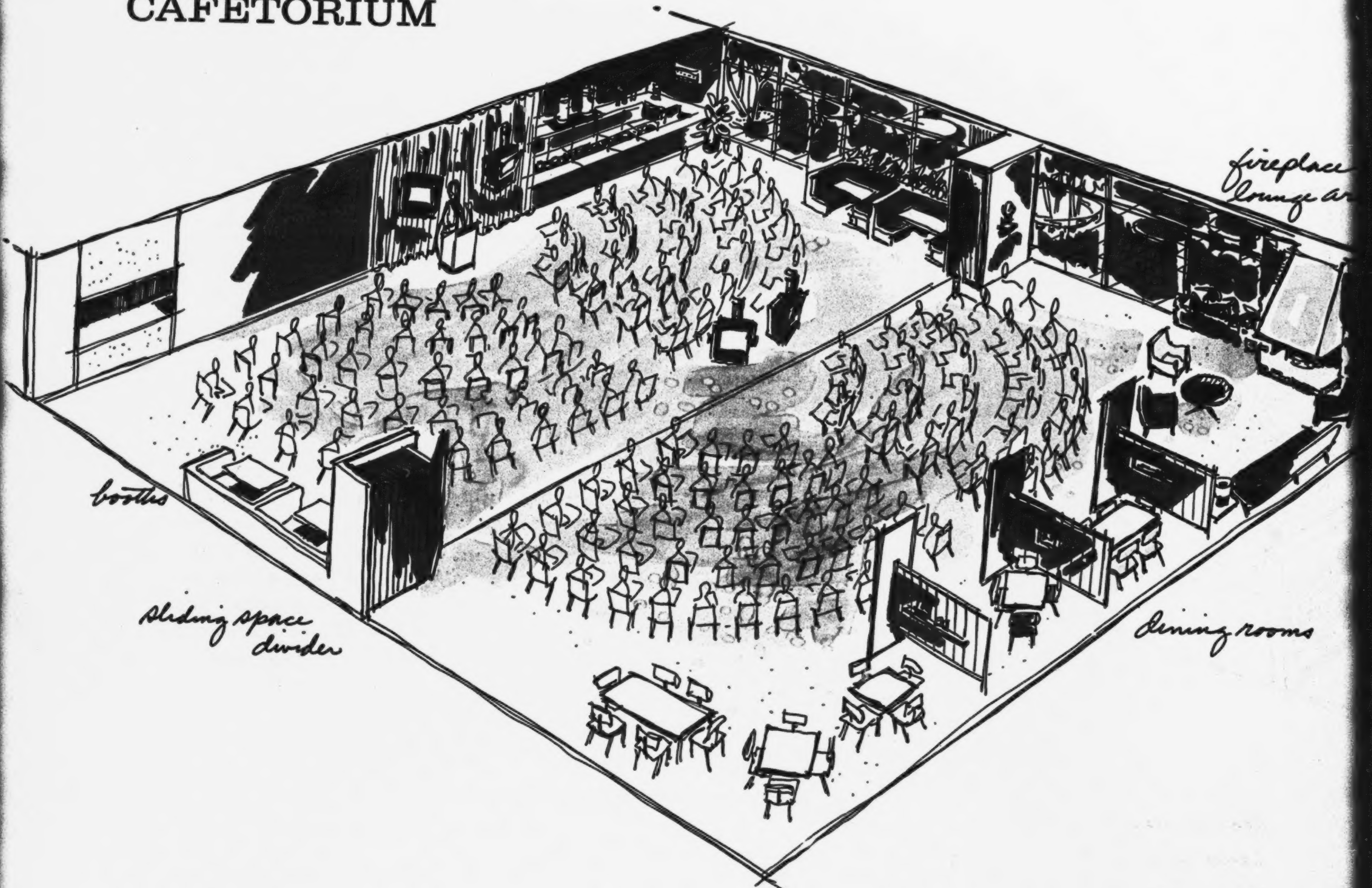

acoustic curtain divider

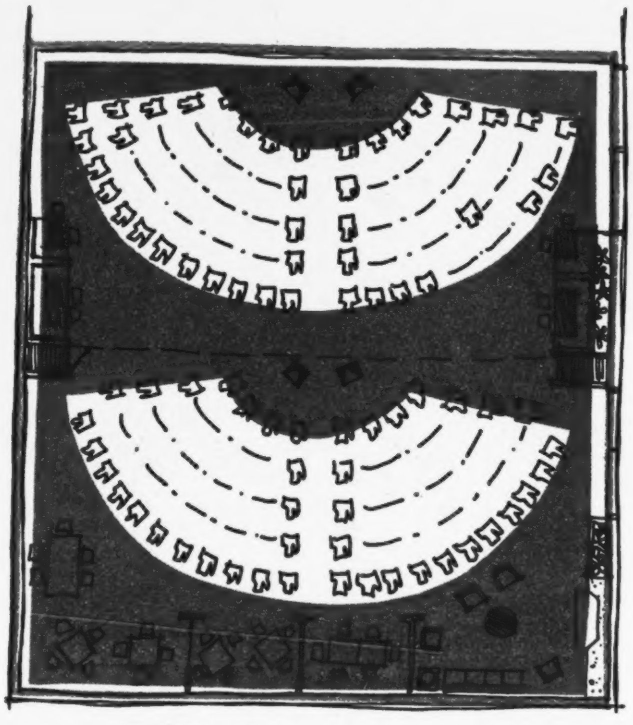


All of the advantages of the individual and combined space groupings can be realized and even extended when clustered around a central audio-visual and resources core. Such a combination might be a complete school unit in itself, a wing of a large school or a school-within-a-school. Note the use of rear-screen projection equipment for visuals distributed to various rooms from the central location.

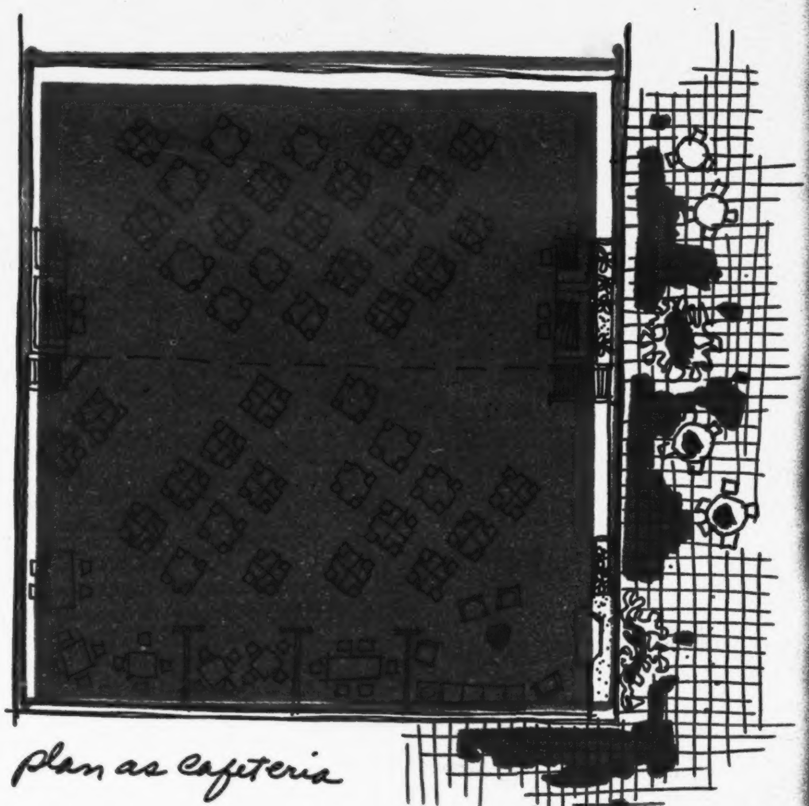

rear screen projection equipment with projection from core
Combination - 6 classrooms (2 double size) around a central audio-visual resource + equipment core
May be single large hexagonal classroom

CAFETORIUM

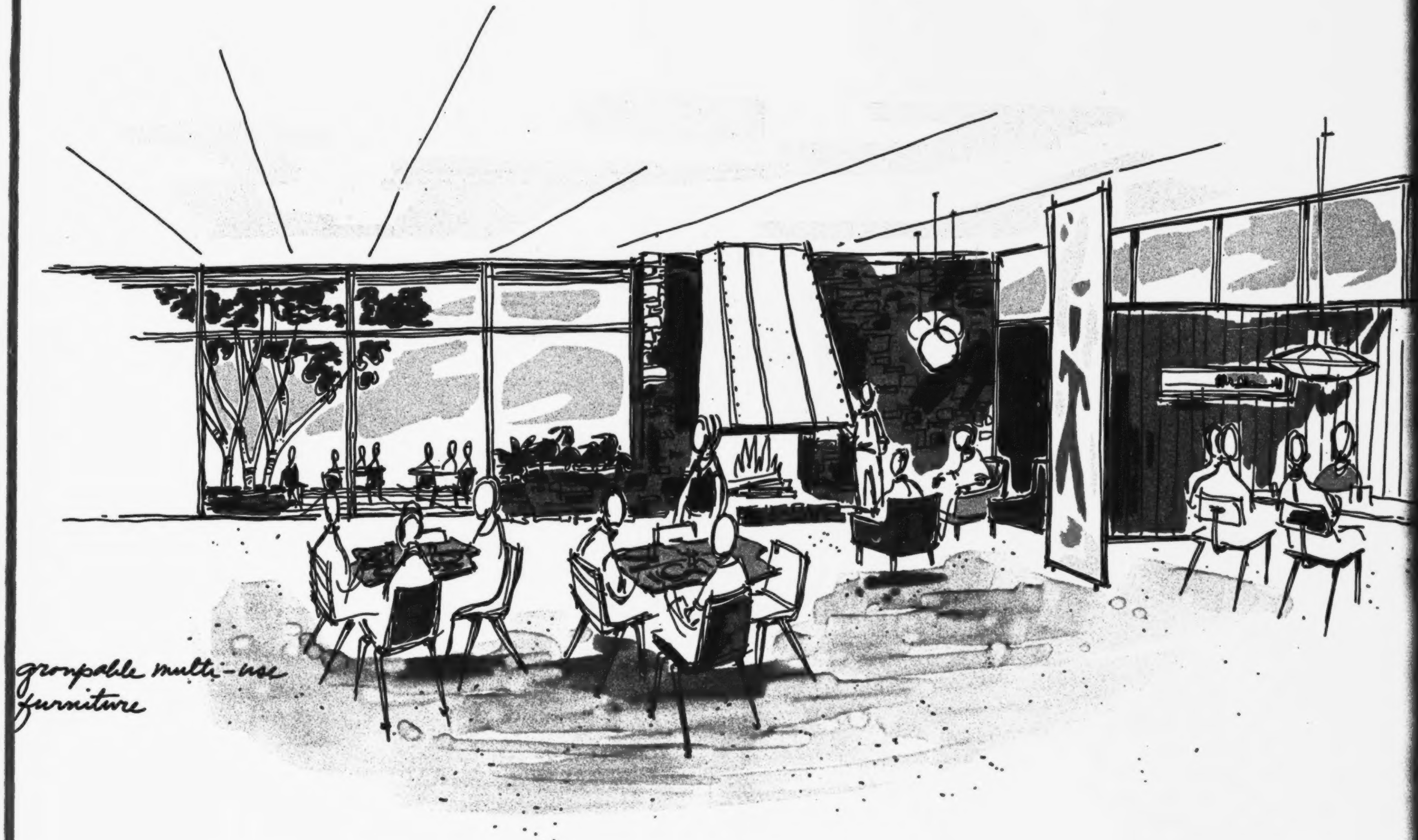

fireplace
lounge ar
booths
sliding space divider
dining rooms



plan as television class



plan as cafeteria



Large school spaces such as cafetoriums can be designed more effectively so that they can actually be used for more than one activity and through all hours of the day.

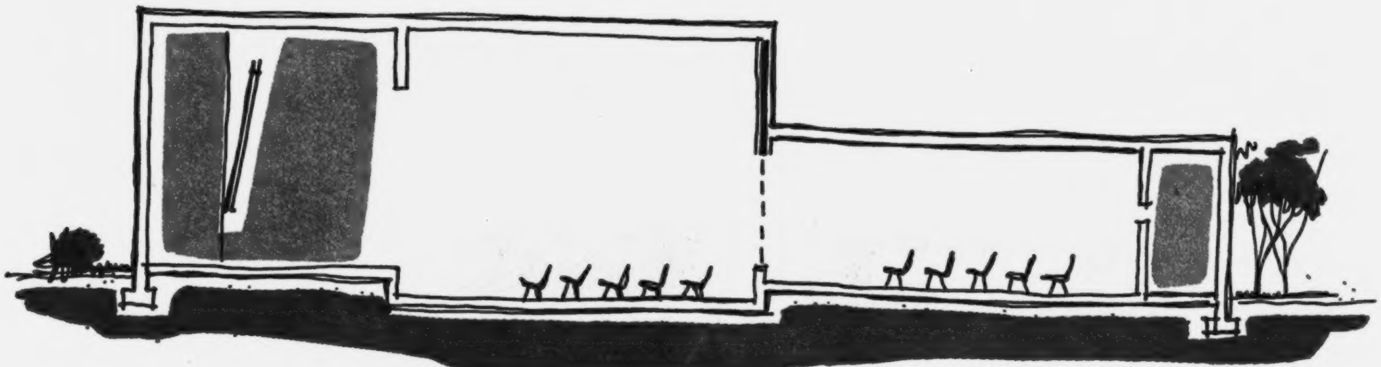
As shown in these sketches, the two large areas are divided by a folding acoustical partition so that they can be used individually or in combination. Variations in seating arrangements assume multi-purpose furniture that could be grouped for dining or rearranged as individual units with writing surfaces for note-taking during lecture or televised courses. Multiple receivers assure a full view of the televised course from any seat location.

Small group spaces around the perimeter of the rooms provide informal dining areas as well as spaces for study, teacher counselling or student conferences.

Food service could be provided from rolling hot carts or from service area set off from one of the main rooms behind an acoustical partitioning wall to prevent intrusion of kitchen sounds in the adjoining study room.

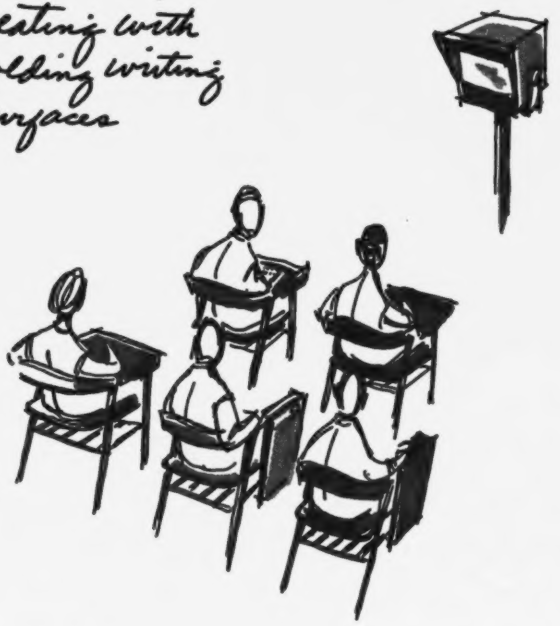
With the addition of a movable stage platform, such space could serve for little theater activities, social meetings in after-school hours, etc. Where possible, these areas should be accessible to the outdoor court areas equipped with tables and chairs for both dining and class meetings.

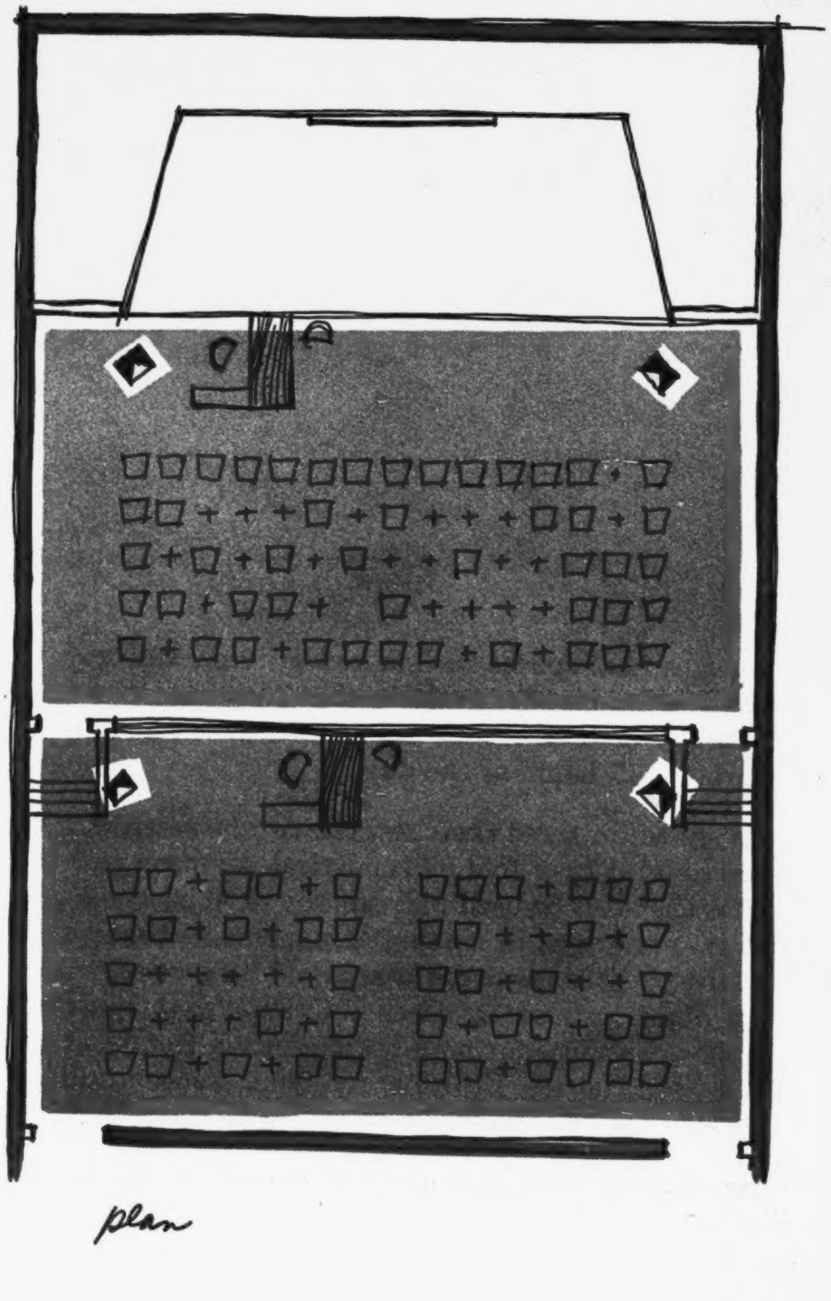
LARGE GROUP SPACE



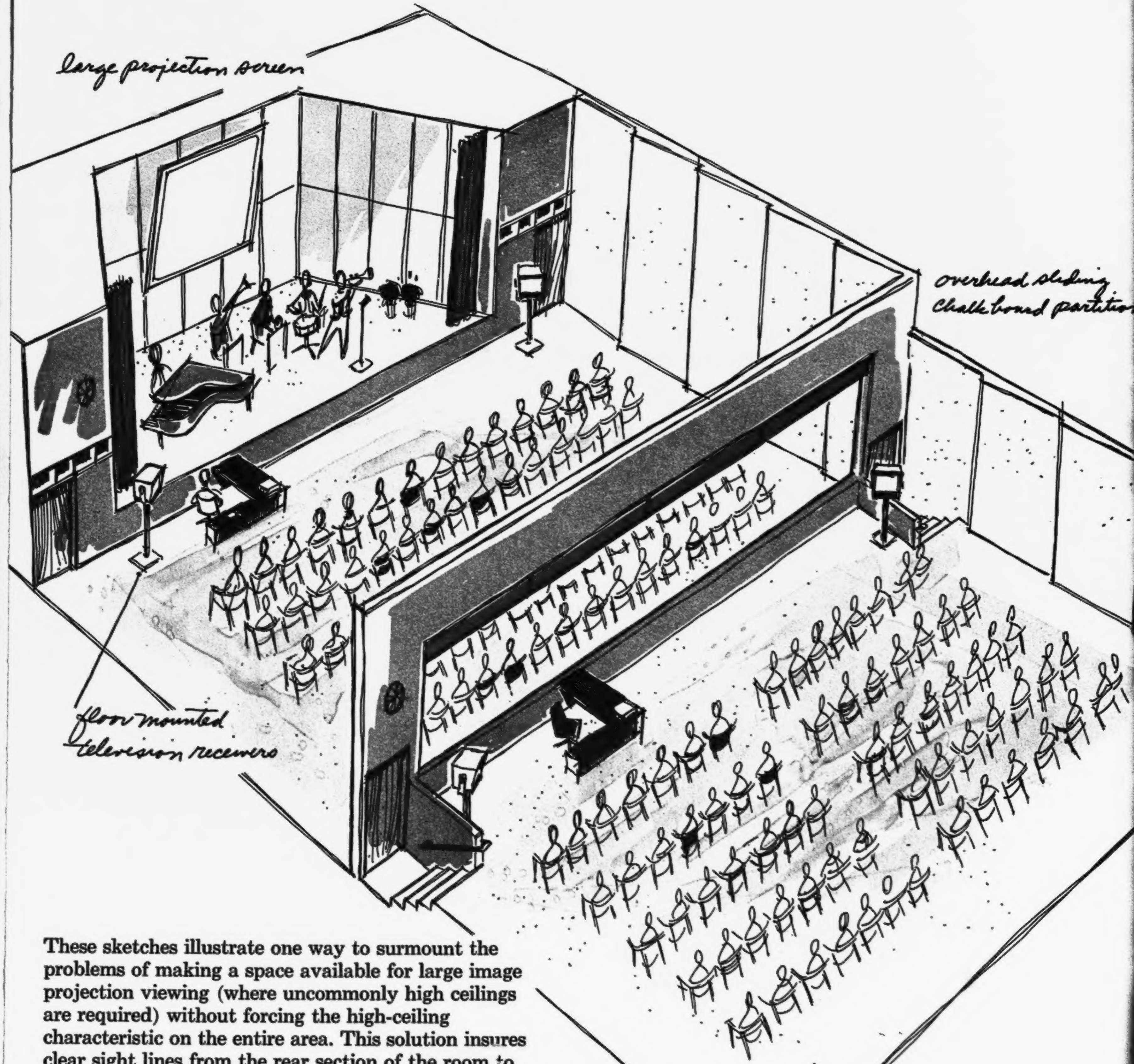
Section—showing tiered floor

Seating with folding writing surfaces



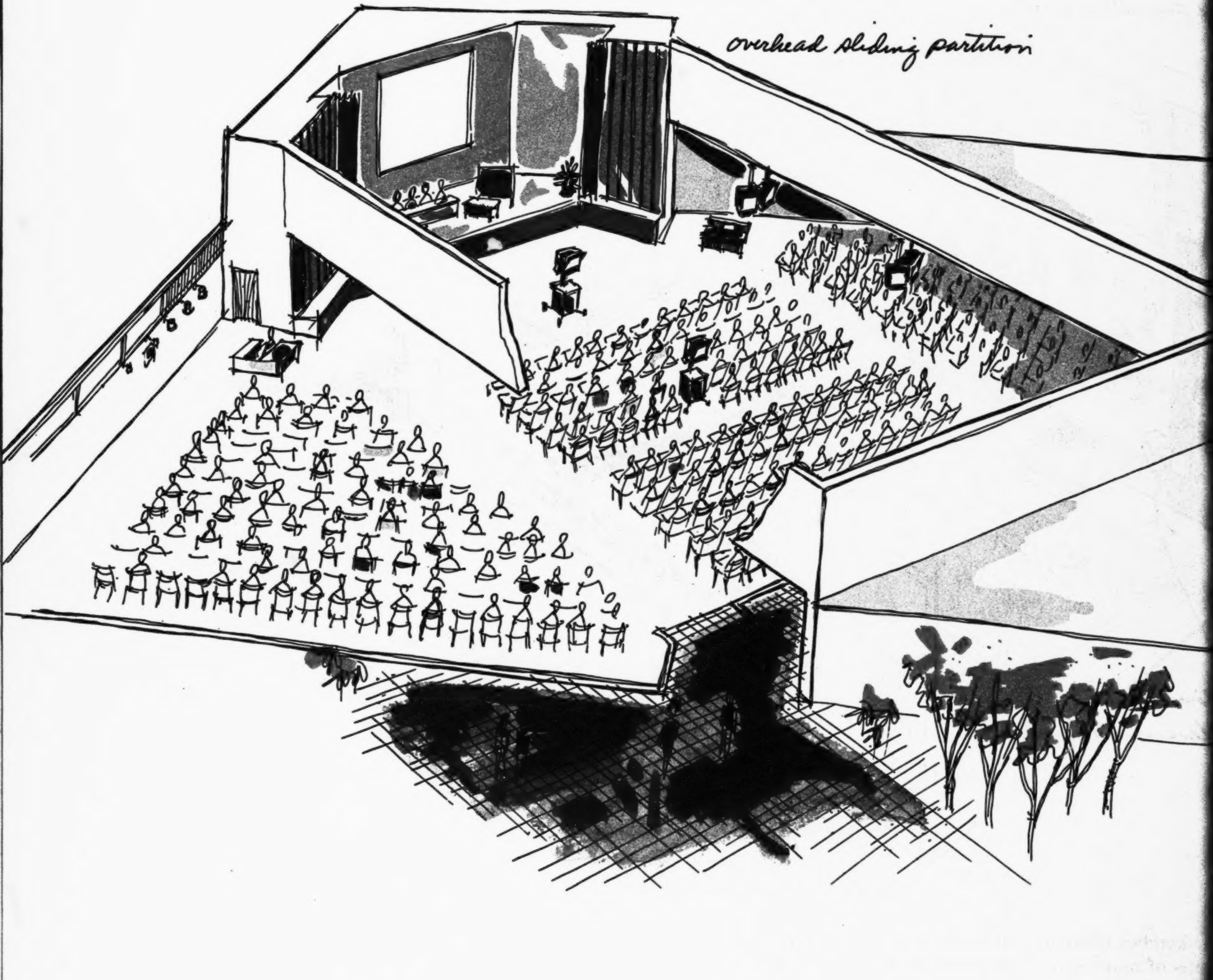


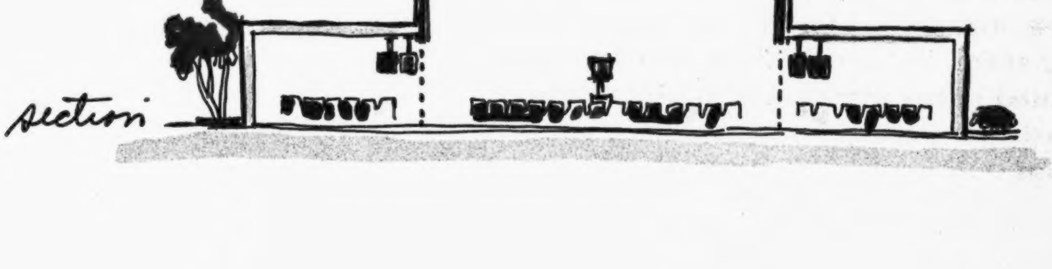
plan

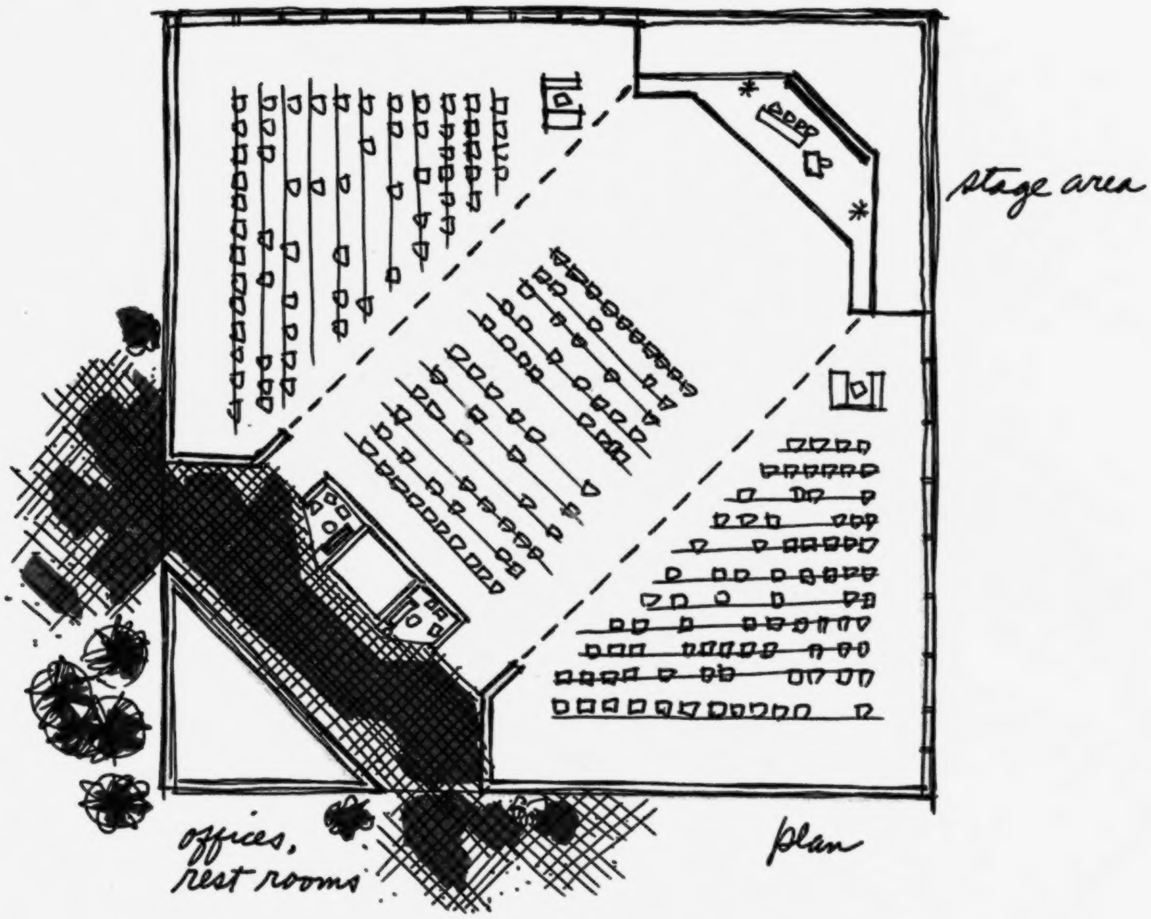

large projection screen
overhead sliding
Chalkboard partitio
floor mounted
television receivers

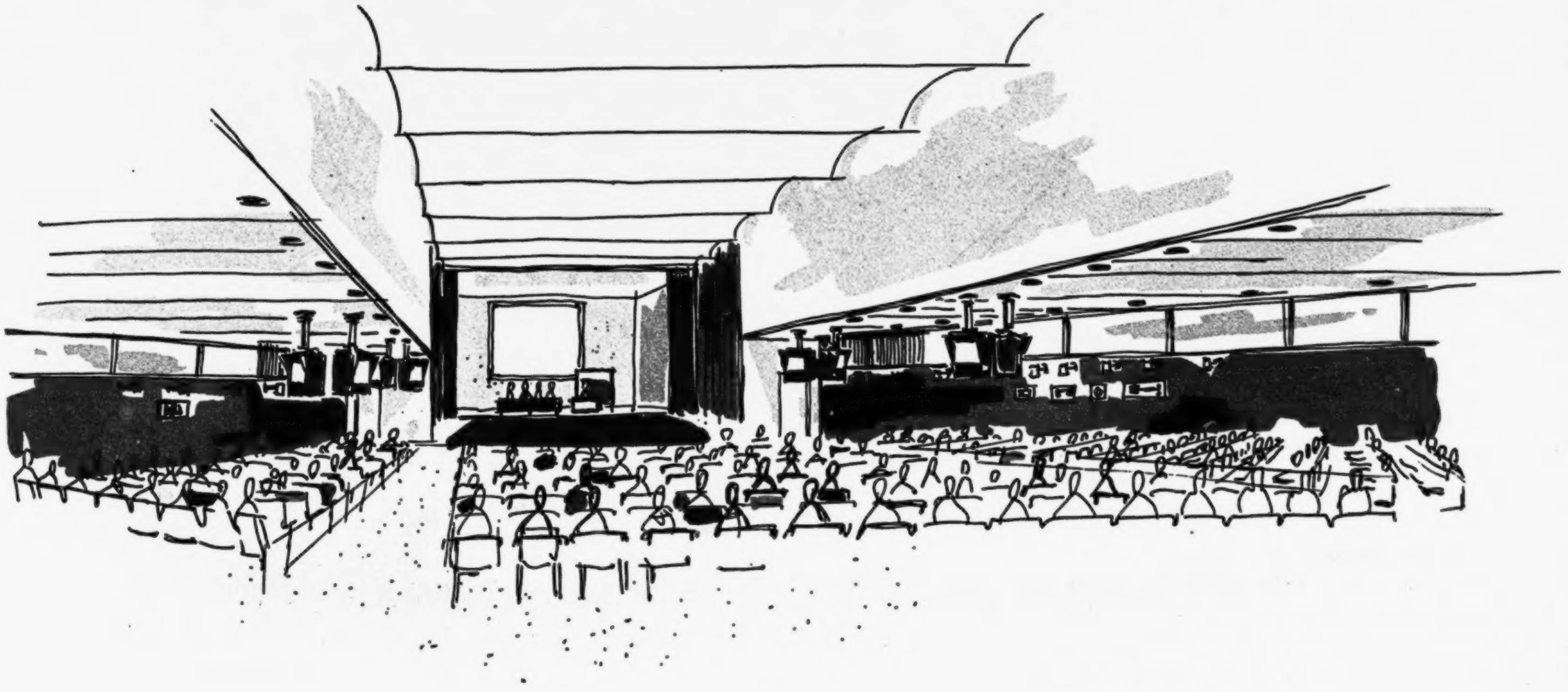
These sketches illustrate one way to surmount the problems of making a space available for large image projection viewing (where uncommonly high ceilings are required) without forcing the high-ceiling characteristic on the entire area. This solution insures clear sight lines from the rear section of the room to the large screen mounted on the front wall. Seating level of the front area is recessed. These sight lines are, of course, maintained for any activity on the little theater stage, lecture platform or other raised element located in the same position. Acoustical overhead partition separates the two areas for individual use.

LARGE GROUP SPACE 200 OR MORE


overhead sliding partition

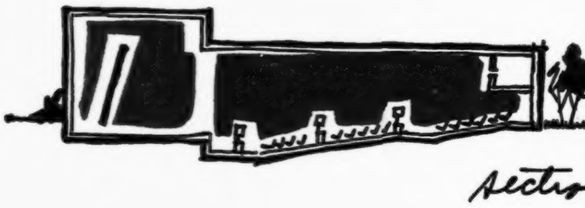


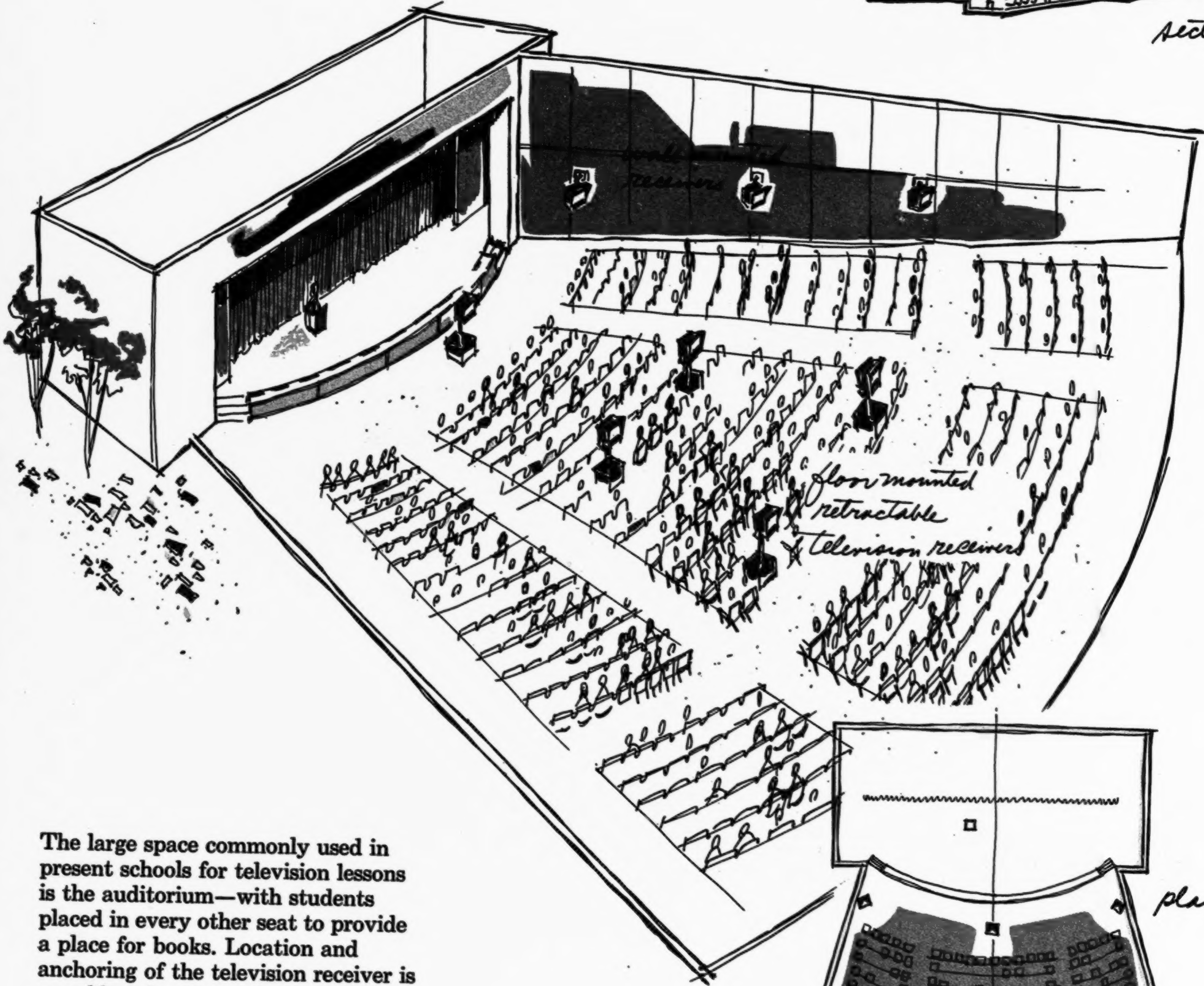


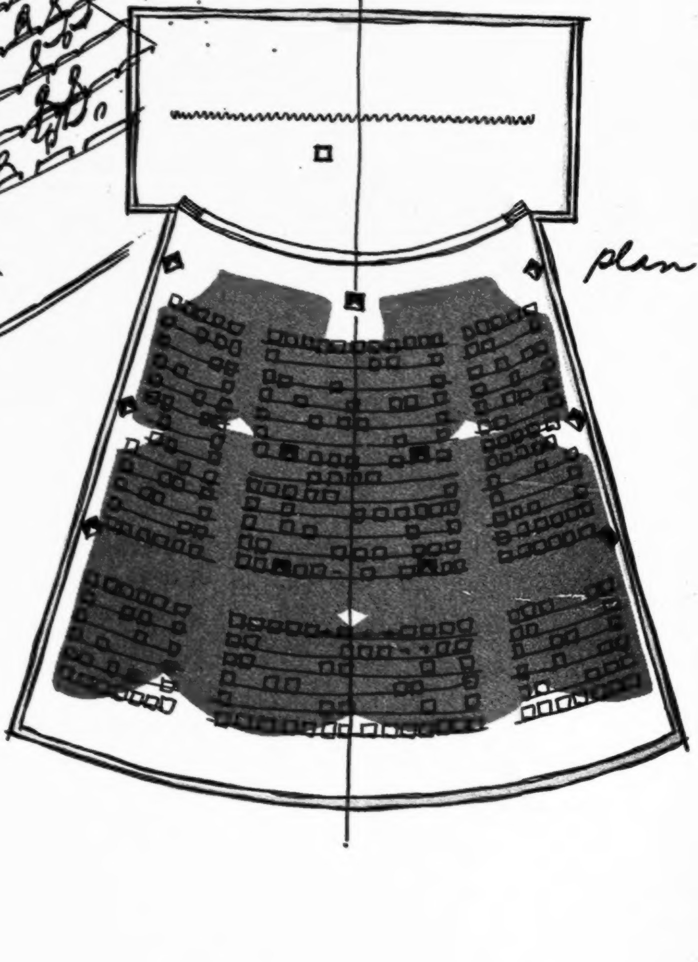


A total group of 300 students or three groups of 60-60-175 are accommodated by combination of the large rectangular assembly space flanked on either side by two meeting rooms for 60 students each. As suggested here, the areas are divided by overhead sliding partitions to provide privacy and block out transmitted sounds from one area to another. Acoustic treatment and ventilation of such large areas require professional attention.

EXISTING AUDITORIUMS

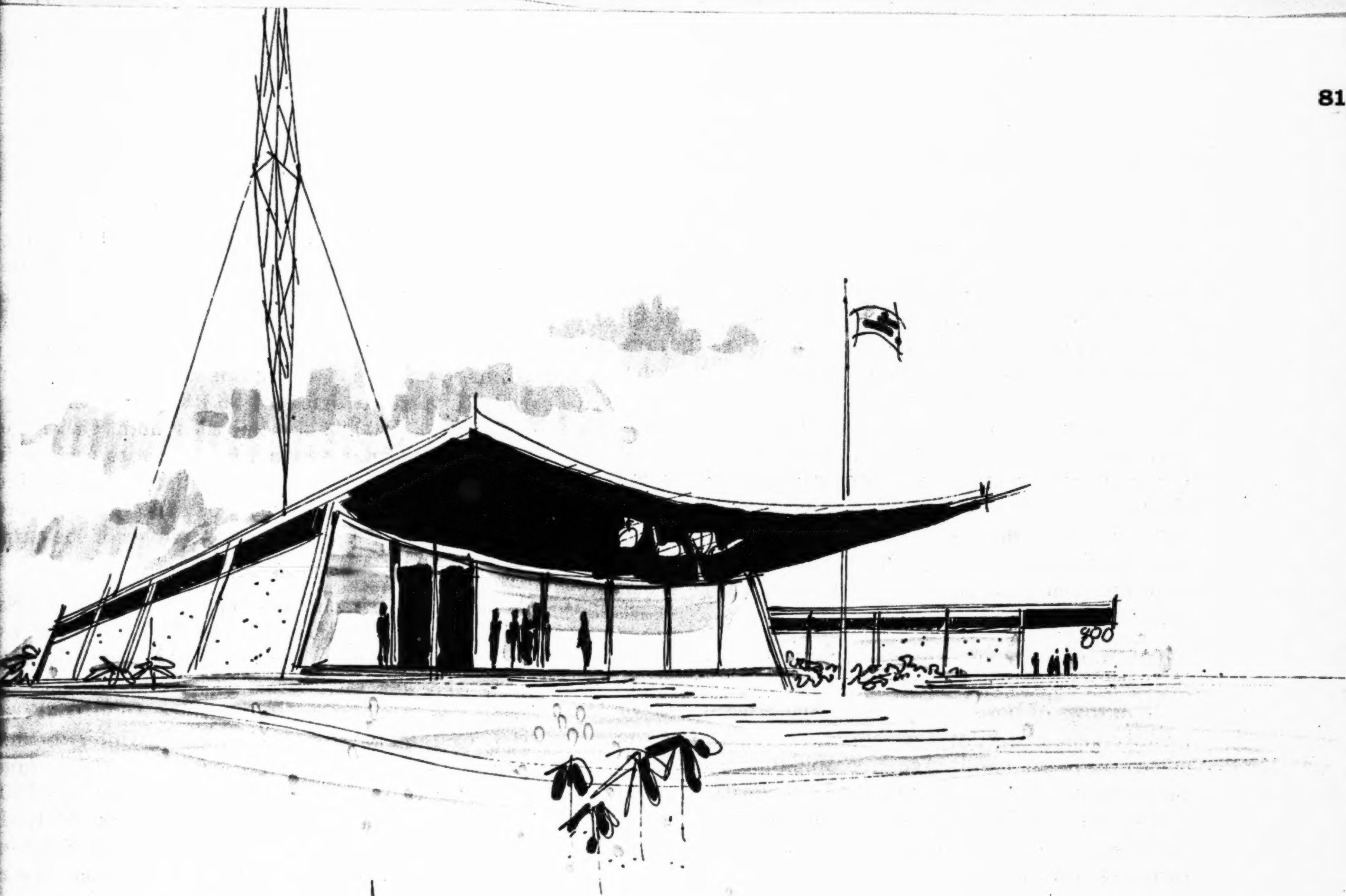



wall mounted receivers
floor mounted retractable television receivers

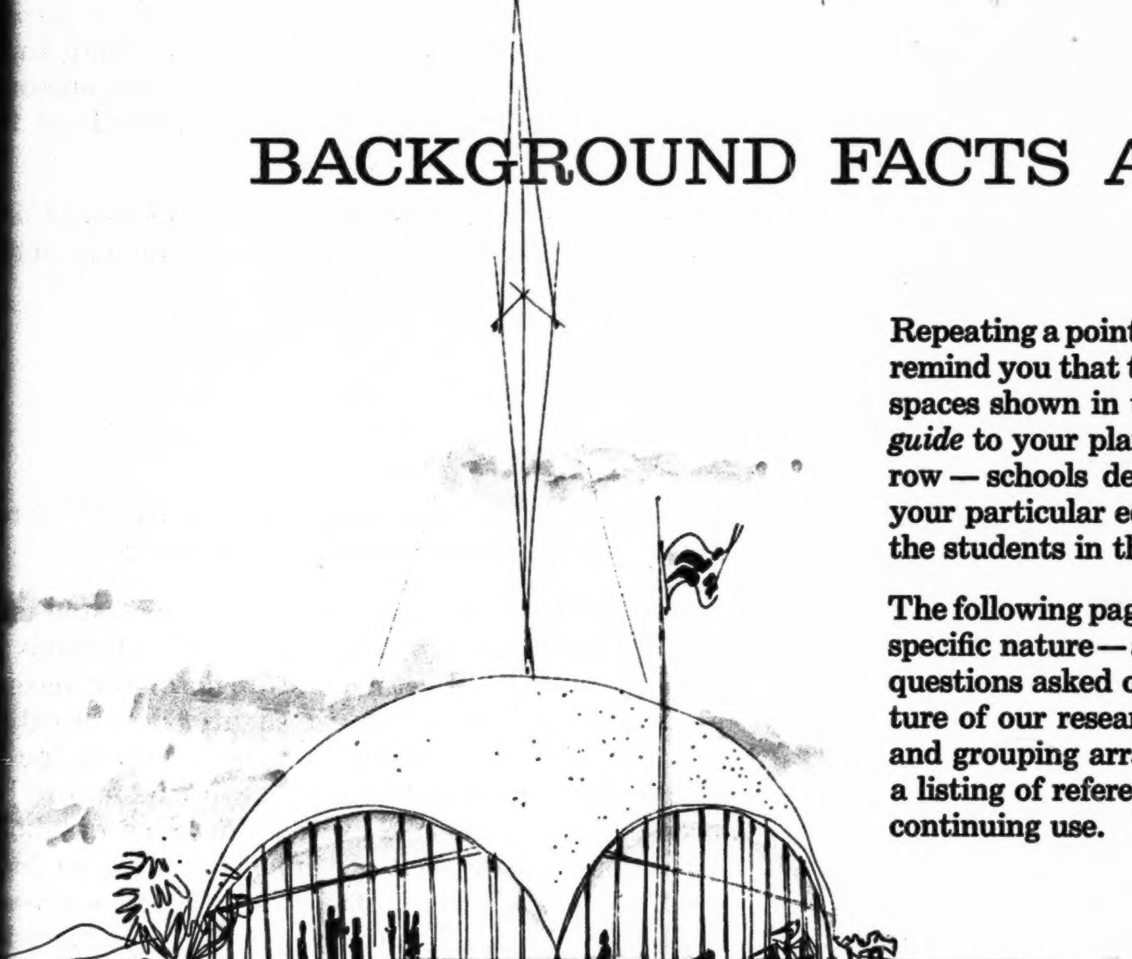


The large space commonly used in present schools for television lessons is the auditorium—with students placed in every other seat to provide a place for books. Location and anchoring of the television receiver is a problem due to the slope of the floor.

By removing a few seats, receivers can be mounted as shown in the sketch and retracted into the protective housing when not in use. (This box housing should not be higher than the back of any seat or else it will restrict the view to the stage when the room is used for lecture, theater, etc.) Wall mounted receivers serve the side aisle viewers.



BACKGROUND FACTS AND SOURCES



Repeating a point from the introductory comments, we remind you that the sketches and diagrams of learning spaces shown in this report are intended to serve as a *guide* to your planning of schools for today and tomorrow — schools designed to meet the requirements of your particular educational program and the needs of the students in those schools.

The following pages provide additional guides of a more specific nature — answers to some of the more frequent questions asked of the design team; reports on the nature of our research studies; charts of various seating and grouping arrangements in the learning areas; and a listing of references and bibliographic notes for your continuing use.

Questions from the Field . . .

Q. Are current classrooms suitable in shape and size for instruction with television?

A. Spaces that already exist in many schools across the country are in themselves suitable for the use of instructional television—but in too many cases they are seldom being used to full advantage even for traditional teaching processes. For example: In most cases of a square or rectangular classroom, student seating is normally oriented to face a flat wall. If the focus of the group were centered on a corner of the room where the teacher, wall maps, viewing screens and teaching aids were also properly grouped, the side walls of the room would establish the proper visual controls to maintain the focus of student attention within a 90° arc of view.

The studies of room shapes shown in sketches on pages 64-73 indicate that rooms of irregular shape (rather than rows of boxes) may offer some advantages for arrangement of facilities within each area and at the same time be groupable in such combinations as to avoid burdensome structural expenses. Irregularity in room shapes can also be extremely helpful in breaking the institutional look that is such a psychological burden to many educators.

Q. How can television distribution cable and wiring be installed in existing buildings?

A. Coaxial cable used for distribution of the TV signal within a building ranges in size up to approximately ½" diameter (usually does not exceed ¼"). It is frequently possible to run this cable in raceways or conduits already supplied for an existing sound system, public address system, alarm system, etc. Where conduit does not already exist, air shafts or heating ducts may be useable. Another alternate is to run the cable along an outside molding or against the wall, shielded with protective covering such as wire mold.

Q. Have any experiments with carpeted classrooms been undertaken? If so, what were the results re effectiveness, cost, maintenance, acoustics, etc.?

A. There are two such major experiments on record in areas of widely different climatic conditions. One of five primary school units in the Andrews School System, Andrews, Texas, was carpeted in 1956 (Peter Pan Elementary—see photograph, page 46). For 27 months custodial costs were recorded in the wool-carpeted unit and in the four identical units floored with vinyl tile. Total comparison of costs estimated and projected over a nine year period (including installation and materials) indicate a figure of $6,193.64 for the carpeted unit and $7,400.83 for the tiled unit. Other factors such as lower damage and maintenance cost on furniture in the carpeted unit, reduction of teacher fatigue from standing on carpet, lower noise levels, improved pupil attitude are all reported in favor of the carpeted unit.

A second experiment was begun in 1958 in the Senior High School wing of Shaker High School, Newtonville, New York. Floors in the identical Junior High School wing were left uncarpeted, as originally finished in asphalt tile. A maintenance study by Industrial Sanitation Counselors over a six month winter-to-summer period showed a time-labor saving of 47% in favor of the carpeted section; maintenance cost saving of 50.4%. An acoustical study made by Prof. Harry E. Rodman and Prof. Carl J. Kunz, Jr., of Rensselaer Polytechnic Institute reported that carpet can cut noise in a room by as much as 50% and that noise level in carpeted corridors was 16 to 22 decibels lower than in uncarpeted areas tested. Psychological improvements in reaction of students and teachers paralleled the findings of the Texas experiments.

(Both studies were supported by the American Carpet Institute of New York who can supply further details; or contact the schools directly.)

Q. Hanging light fixtures cause glare on the TV screen. What can be done to eliminate this condition?

A. Whatever steps are taken will have to be tested in the actual room situation, since angles of reflections can demand minute adjustment of angle of the receiver, etc. First, try tilting the set slightly downward and toward the viewers. Second, attempt to shade the face of the receiver against direct view of the fixture by a hood or fins constructed of wood, metal or cardboard, finished in a matte surface (similar to the "barn doors" used in stage lighting). One school reports success by mounting such shielding panels directly on the side of light fixture facing the receiver. Another teacher reports that the half of the auditorium ceiling globe facing the receiver was covered with black paint to eliminate this reflection. (For further notes see "Lighting," page 45.)

Q. How can light be excluded from a classroom without interfering with air circulation?

A. Complete darkening of a room without an internal or forced air circulation system is almost impossible without cutting off ventilation. Darkening draperies hung away from open windows will allow some circulation of air while deflecting any leaking light to the floor. Venetian-type blinds designed with a light trap will allow only so much air to circulate as there is open space around the blinds (which will reduce the effectiveness of the light seal). Since complete darkening of a room is much less important with television, the opaque projector or rear-screen projection techniques, light diffusion may be all that is necessary unless you plan to employ traditional projection equipment in the classroom.

Q. How can TV sets be installed in existing auditoriums with sloped floors?

A. Several schools now using the auditorium for television classes have built rolling pipe stands designed to account for the slope in the floor and still allow for a tilt of the television receiver downward toward the viewers. Blocking devices or locks for the casters are necessary to prevent the stand from rolling out of position. (See page 48 for a suggested retractable television stand for auditorium use.)

Q. What can we do to adapt our existing cafeteria to use as a television classroom?

A. Since multiple television sets will be used, the problem is not so much one of providing a view of the receivers for each student but rather how does the teacher communicate with the students in a space normally broken with columns and acoustically poor for group teaching. For any large group in a cafeteria, some provision must be made for blocking out the sounds coming from the kitchen. Since cafeteria walls are often hard surfaced (ostensibly for a clinically clean effect), sound reverberation may also be a problem which draw draperies or use of acoustical tiles may correct to some extent. Using the audio system of every other speaker as the sound source (completely eliminating the audio of the intermediate sets) may reduce overlap of sound and sound reflections. If the teacher uses a public address system, a series of low level speakers will provide better and more comfortable hearing conditions than a single source at high volume at one end of the room.

Q. How do we buy television sets for our school? What are educators' prices? Where are the educators' outlets?

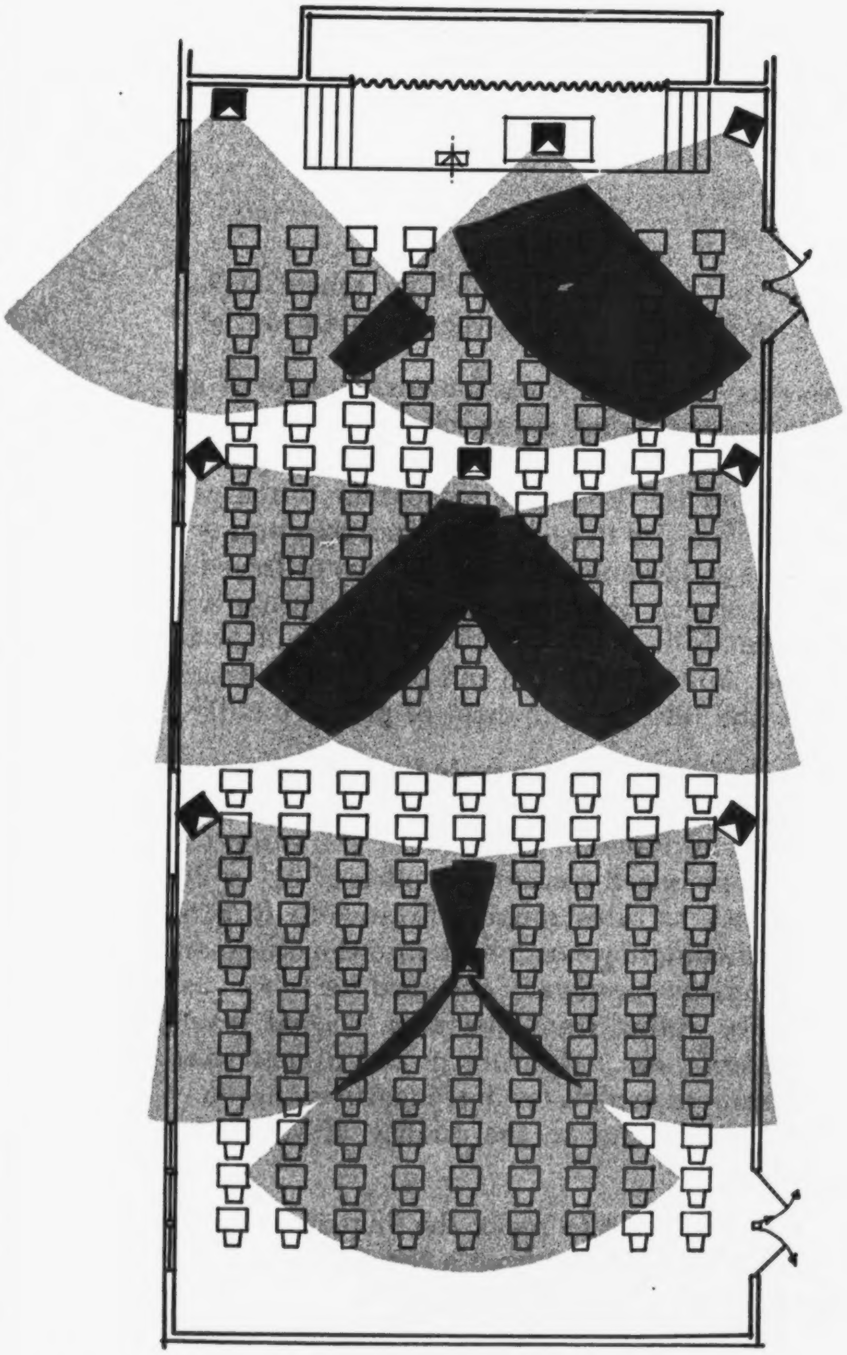
A. Where television is used only for enrichment of an existing teaching program, many schools have received sets from PTA groups, local business groups and in some cases from the Board of Education (often one set of a prescribed size to each school in a community). If television is to become a considered part of the educational program in your community, provision will have to be made in the total educational budget to allow for the planned purchase and proper installation of receivers and related equipment of proper quality.

Pricing of television receivers in today's market is as erratic as the pricing and costs of appliances. According to quality and function of the units, you can probably purchase standard consumer models of 21″ or 23″ sets in quantity at rates ranging from $140 to $180 per set. You should, however, check into the classroom television receivers specifically designed for school use (better quality audio, front speakers, special placement of controls, etc.) that are priced higher than standard consumer models but have features that may be extremely important to the quality of your educational program.

You will probably wish to make the final purchase of equipment in any quantity from a reliable distributor or dealer who is close enough and has the facilities and skills for regular maintenance checks and adjustments as well as proper installation. You can, however, make your initial contact for information relating to your needs through the main office of any of a number of manufacturers (see references on page 95).

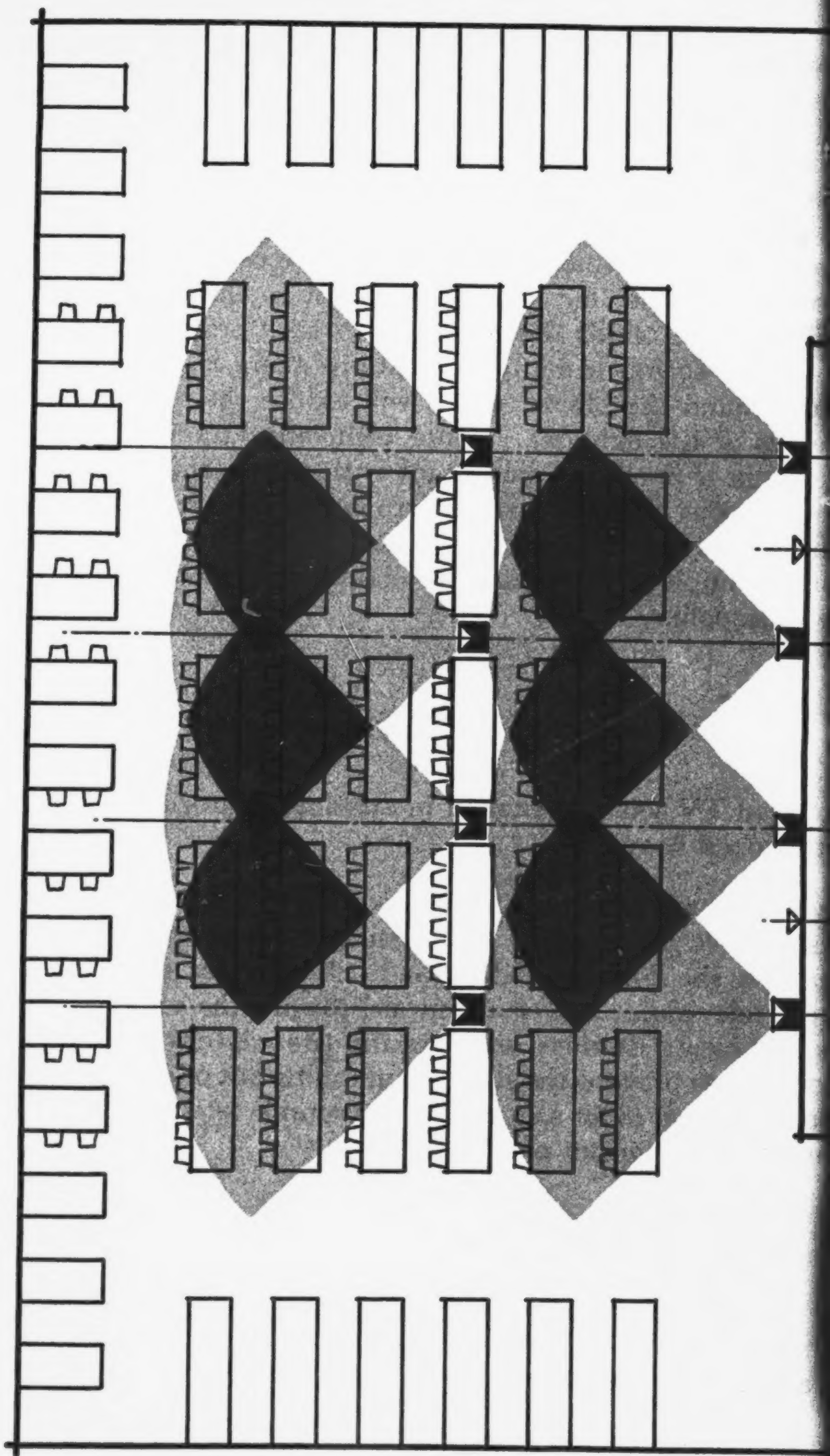
Using Existing Spaces...

The two plans demonstrate how large group television classes are currently arranged in a large study hall and a cafeteria in the Milwaukee School System visited by the design team. Seating in the study hall is fixed; nine sets are used with those at the sides of the room mounted on wall brackets six feet off the floor to allow students to use the aisle space for normal passage. In the cafeteria students are seated only on one side of the dining tables; sets at the front of the room are also bracketed six feet from the floor level. A team of two teachers directs each instructional program in the cafeteria space; one teacher handles each section in the study hall. Public address systems are used in both spaces.



History and Biology classes, 11th grade, 196 students
Bayview High School—Milwaukee, Wisconsin

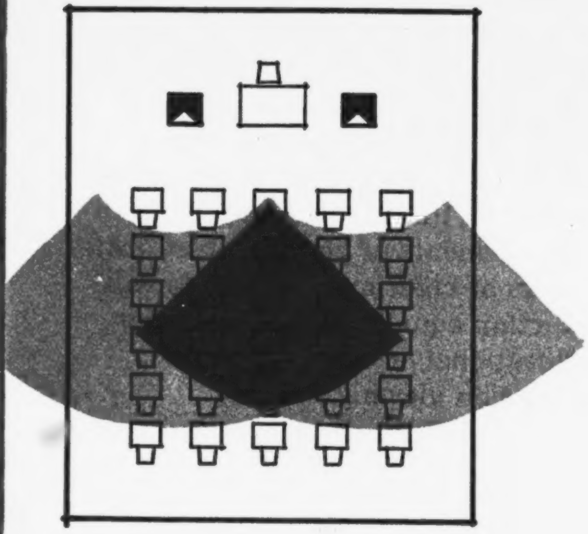
21″ receivers

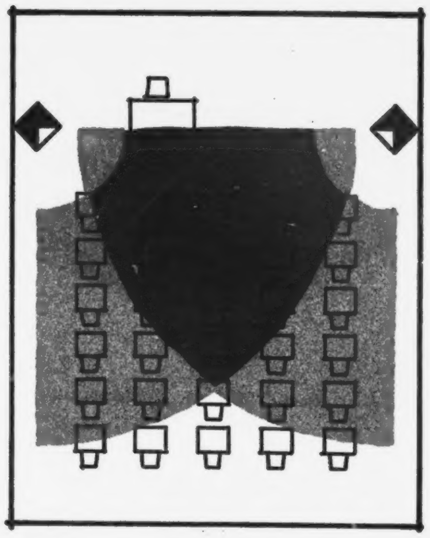


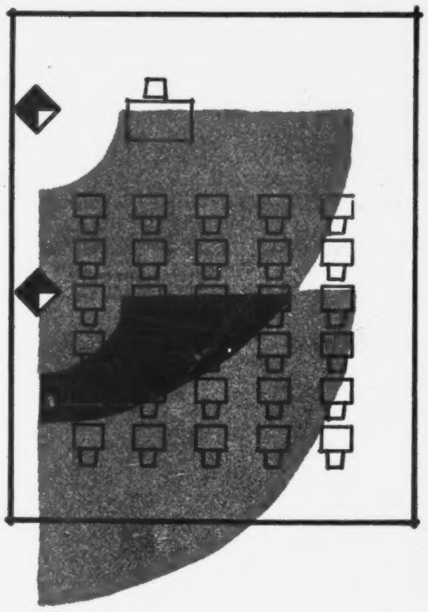
General Science class, 9th grade, 200 students
Steuben Jr. High School—Milwaukee, Wisconsin

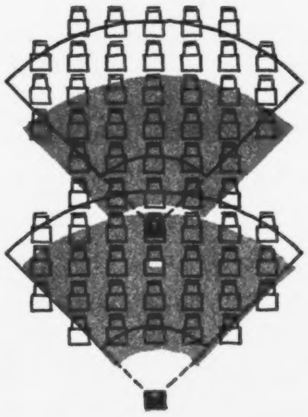
21″ receivers

The number of television receivers to be used in any learning space will be determined by the number of viewers in the class group and the type of furniture in the space. For the traditional classroom group of 30-45 students with individual desks and chairs permanently mounted on the floor, two 23″ receivers will probably best meet the requirements. As shown in diagrams directly below, several variations in placement of the receivers are possible.

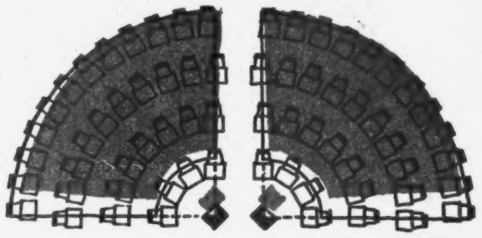


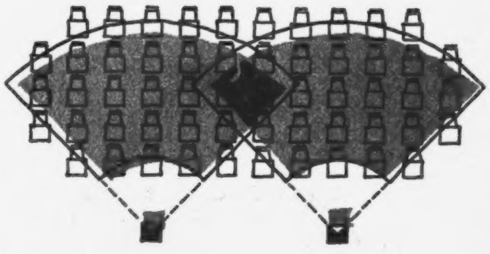


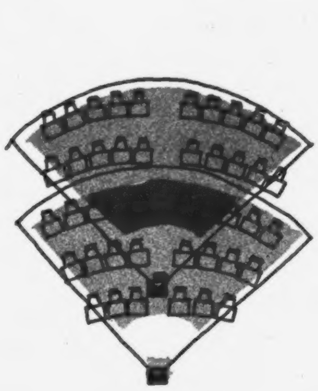


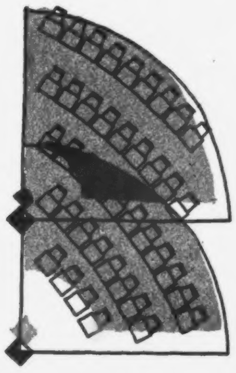


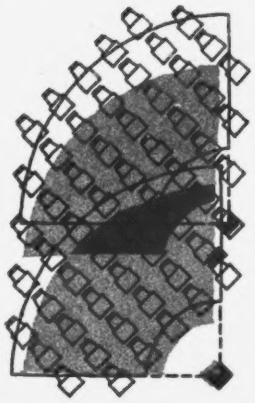
Where desks and chairs are not permanently mounted, there is greater flexibility not only in the arrangement of the students, but also in the placement of the receiver. Several suggested possibilities are detailed here, with the seating area for the 24″ receivers outlined in black and the seating area for 23″ receivers shown in color. As the size of the group increases, more sets will have to be added. To insure a clear view of a screen for each student, it is generally best to account for an overlapping of the potential viewing areas.

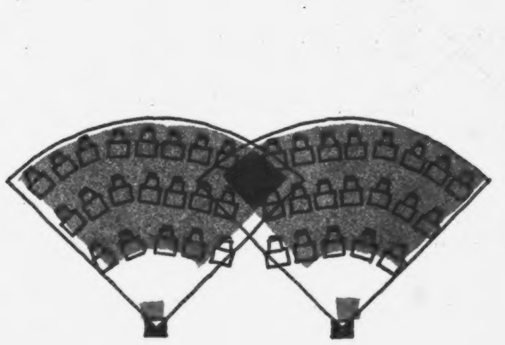






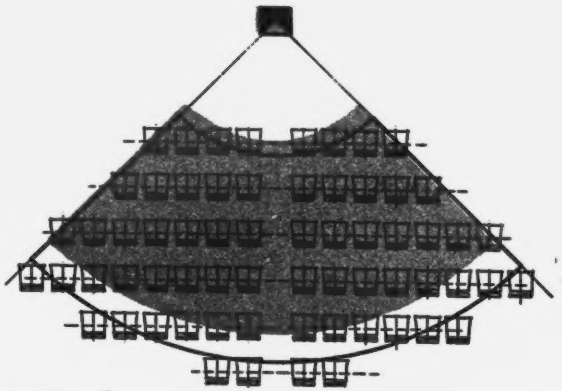






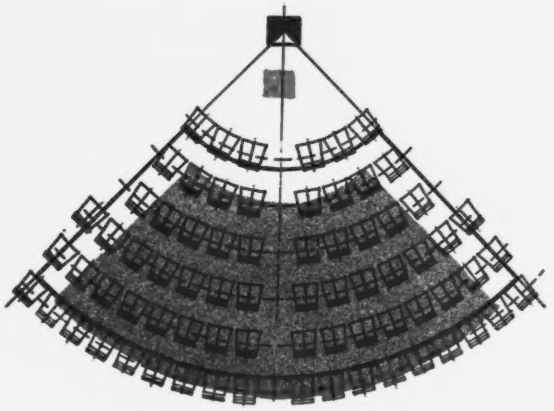
Varied Seating Arrangements

The seating diagrams on this page illustrate various ways of grouping school furniture to meet the maximum audience potential of 23″ and 24″ television receivers. All seating and writing units within the confines of the black line for 24″ sets or the colored area for 23″ sets meet requirements of both minimum and maximum viewing distances as well as maximum viewing angle prescribed earlier in this report. These arrangements of chairs, tablet arm chairs or chair and desk units will function equally as well for other educational activities besides television viewing.

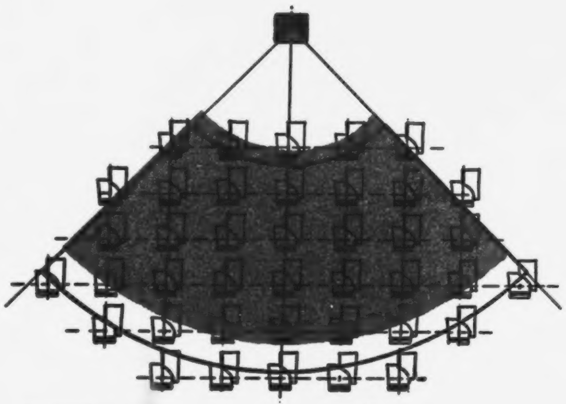


Chairs

3'-0" seat row spacing

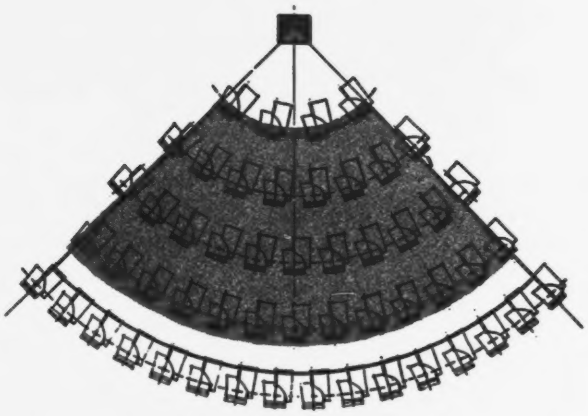


3'-0" seat row spacing

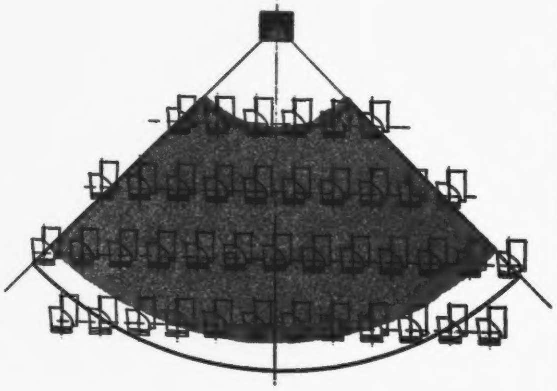


Tablet Arm Chairs

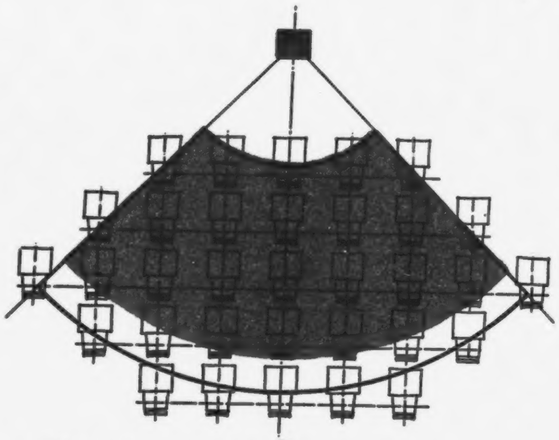
3'-0" seat row spacing



4'-4" seat row spacing

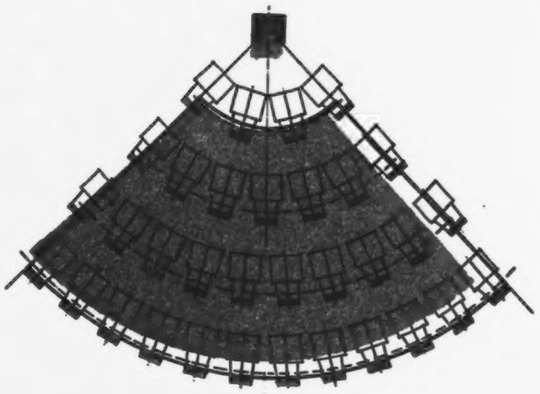


4'-4" seat row spacing

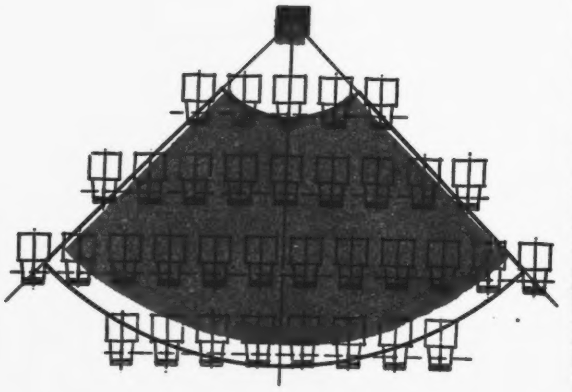


Chairs and Desks

3'-2" seat row spacing



5'-2" seat row spacing



5'-2" seat row spacing

Types of Receivers

1. VHF TV Receiver (image and sound)
    - a. VHF Channels 2-13. Monochrome image only
    - b. VHF Channels 2-13. Color, and monochrome image

    This includes all "home" TV Receivers
2. VHF-Video TV Receiver (image and sound)
    - a. VHF Channels 2-13
1 Video Channel, 1 Audio Channel

    These are, at present, manufactured for educational and industrial use
3. VHF-UHF TV Receiver (image and sound)
    - a. VHF Channels 2-13
UHF Channels 14-83
    - b. VHF Channels 2-13
UHF Channels added as needed

    This includes many "home" TV Receivers
4. VHF-UHF-Video Receiver (image and sound)
    - a. VHF Channels 2-13
UHF Channels 14-83
    - b. VHF Channels 2-13
UHF Channels added as needed
1 Video Channel, 1 Audio Channel

    These are, at present manufactured for educational and industrial use
5. Video Monitors (image only, sound available on special order)
    - a. Standard (Broadcast) type
    - b. High definition
    - c. Color monitors
    - d. Projection (large-screen theatre)
6. Projection Receivers (image and sound)
    - a. Demodulator used in conjunction with projectors to receive VHF or UHF TV signals and display the video on (theatre) large screen

Economic Factors for Educational TV Studios

industry averages
information supplied by
Radio Corp. of America

1. Typical capital costs for a two-camera studio using professional-quality equipment in all cases (audio elements not included)

	Monochrome Vidicon	Monochrome Image Orthicon	Color Image Orthicon
Cameras	$ 19,600	$ 34,400	$ 100,000
Lighting	1,300	1,000	3,600
Other Equipment	4,400	4,400	10,400
Total	$ 25,300	$ 39,800	$ 114,000

2. Annual Operating Costs for a typical two-camera studio, assuming 8-hour day, 5 days/week, 52 weeks/year. Production costs (camera operators, directors, floor managers, etc.) not included

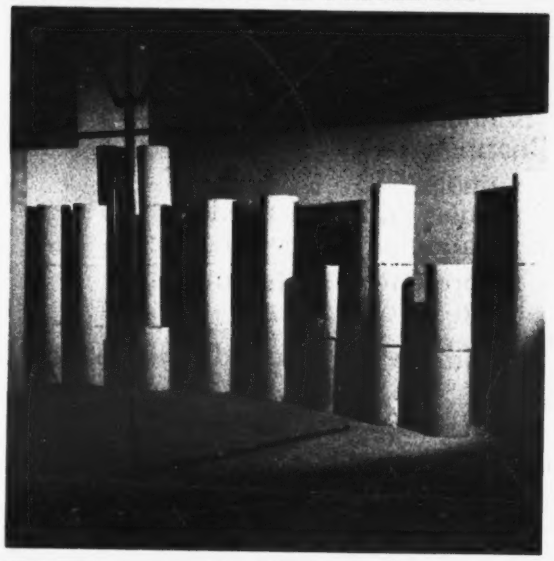
Camera Tubes	$ 183	$ 6,656	$ 41,600
Lighting	374	187	936
Maintenance	3,000	4,500	9,000
Total	$ 3,557	$ 11,343	$ 51,536

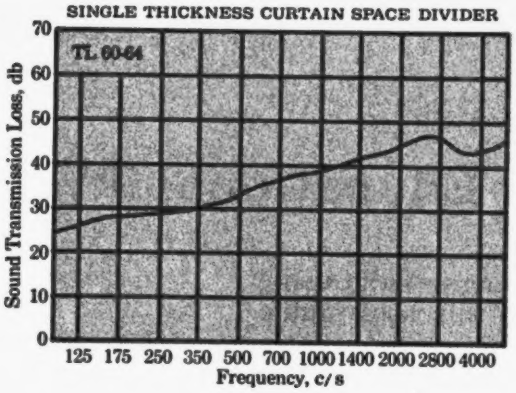
3. Basic Cost Factors used in the above summaries

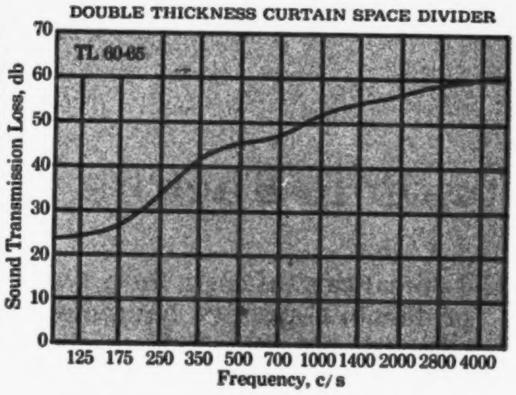
Tube Type	Price	Typical Life	Cost/Hr.	Typical Lighting	Lighting Cost @$1.50/kw hr.
Vidicon	$ 220	5,000 hr.	$ .044	12 kw	$ .18/hr.
Image Orthicon	$1200	750 hr.	$ 1.60	6 kw	$ .09/hr.
Special I.O. for color	$1700	500 hr.	$10.00*	30 kw	$ .45/hr.

*Camera uses three tubes

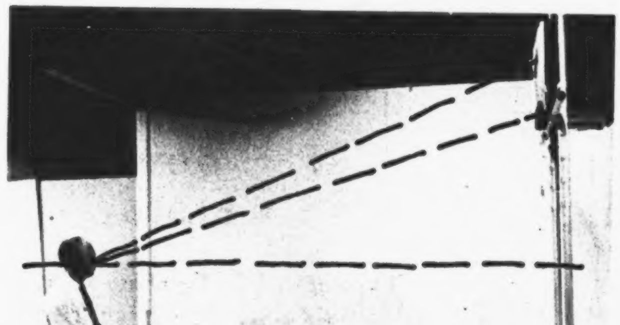
Research Studies

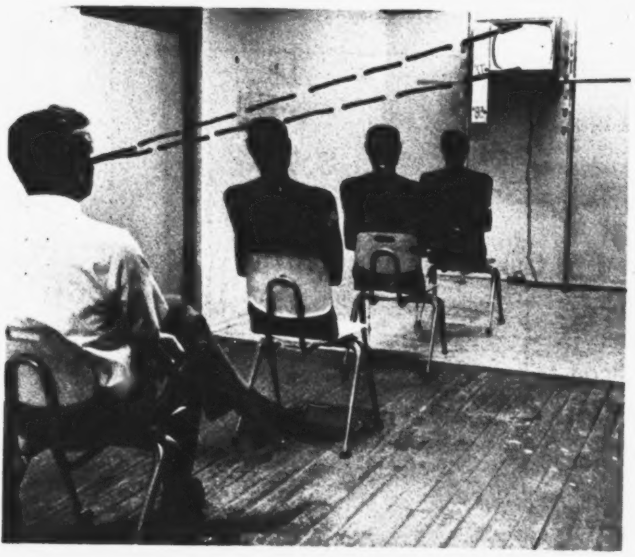






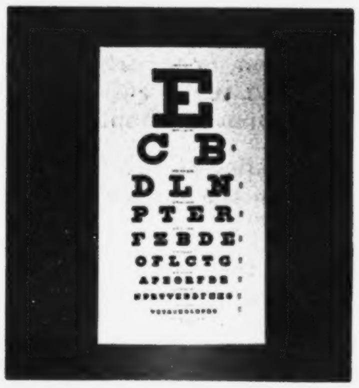
Photographs above record the sound-transmission-loss testing procedures undertaken at the Riverbank Acoustical Laboratories to evaluate the new acoustic curtain space divider developed by the design research team in the course of this study. The results of these tests with a single layer of the material and a double layer divided by air space are shown in the charts. Photographs below demonstrate testing procedures to check out angle of head tilt and seat row alignment and spacing as they affect clear vision and comfort in television viewing in the school.



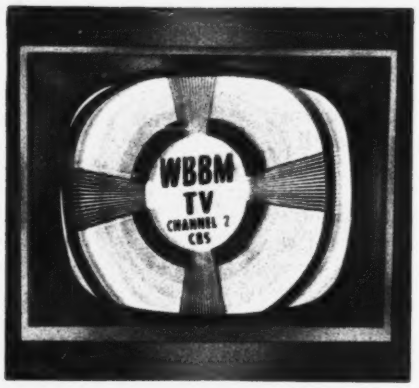


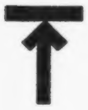
Legibility and Viewing Angles

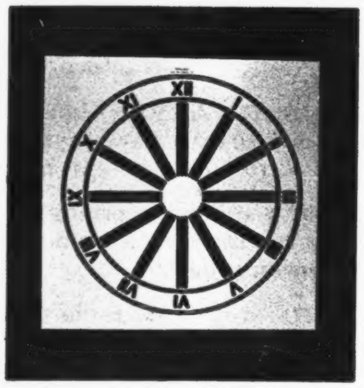
Illustrations are from research tests undertaken by the design team to determine legibility of a televised and/or projected image as it is affected by variations in the angle of viewer to center axis of the screen.

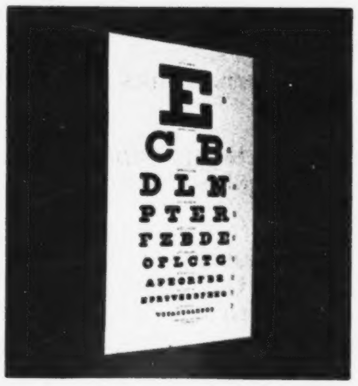

E
C B
D L N
P T E R
F Z B D E
O F L C T G

Head-on
0°

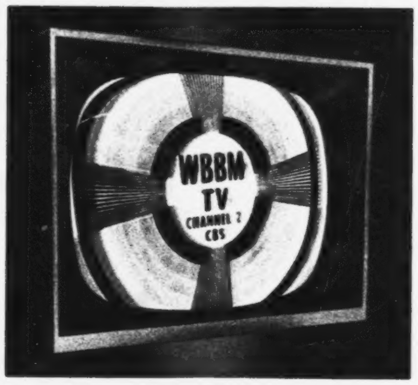

WBBM
TV
CHANNEL 2
CBS







30°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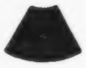
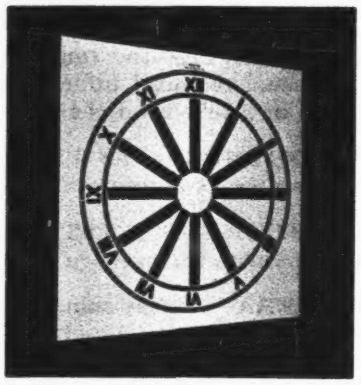
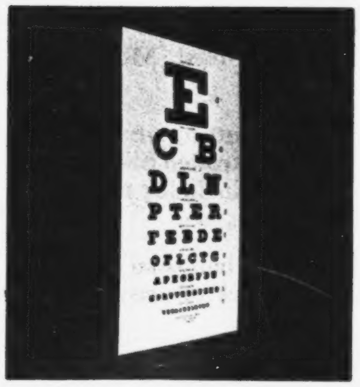
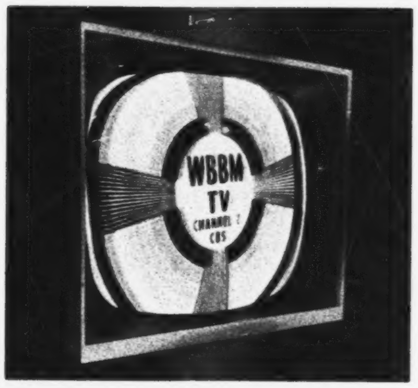






45°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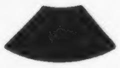
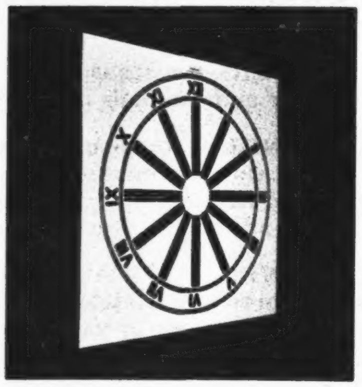
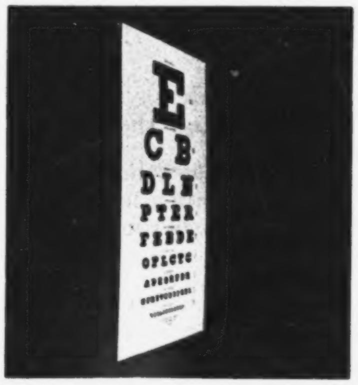
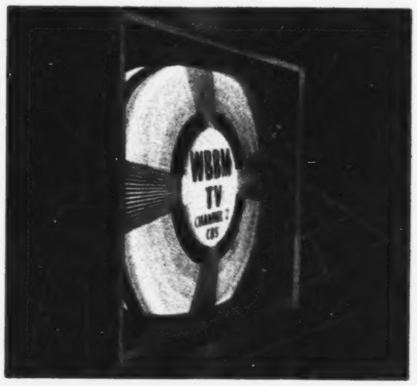




Beyond this point distortion normally becomes objectionable—legibility deteriorates



60°


WBBM
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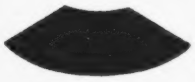

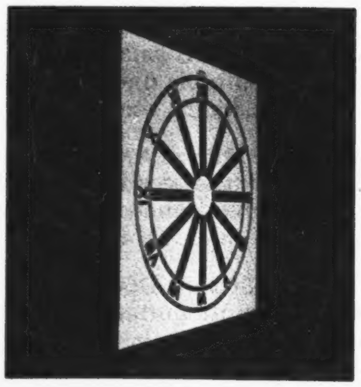

Glossary of ETV Terms

ACOUSTICS—the science of sound; the sound properties of a room or space

ADJACENT-CHANNEL INTERFERENCE—interference caused in one radio circuit by a transmitter which is assigned for operation in an adjacent channel

AMPLIFIER—electrical device through which a sound or picture signal is strengthened

ANTENNA—a structure for sending or receiving radio waves

ANTENNA ARRAY—an arrangement of two or more antenna elements to form a system that operates as a unit; term especially applied to antennas with more than one element

AUDIO—of or concerning sound; specifically, the electrical currents representing a sound program or the sound portion of a television program

BAND—a range of radio frequencies within two definite limits and used for a definite purpose; for example, the standard broadcast band extends from 550-1600 kilocycles, television from 54-216 megacycles, and international broadcasting uses several bands between 6,000 and 22,000 kilocycles

BANDWIDTH—the range of frequencies required to convey the visual or aural information being transmitted; the bandwidth of a television channel in the U.S. is 6 megacycles

BRIGHTNESS—the comparative intensity of light which the eye can see as illuminating an object or screen

BRIGHTNESS CONTROL—knob on a television receiver which varies the average illumination of the image

CAMERA—in television, a unit that contains an optical system and a light-sensitive pickup tube that converts a visual image into electrical impulses when properly scanned

CAMERA CHAIN—TV camera plus electronic equipment necessary to deliver a complete picture for telecasting

CARRIER—the transmitted electrical wave that carries the video or audio signals or impulses impressed upon it

CHANNEL—a range or "band" of frequencies assigned for the transmission of communication signals; in television it is the group of frequencies comprising the transmitted visual (video) and sound (audio) signals

CHANNEL ALLOCATION—the channel or band in the radio spectrum to which a television station is assigned, or the channel space in the radio spectrum to which a communication service is assigned

CLOSED CIRCUIT—a wire circuit used as one means of carrying and directing a television program for specialized audience viewing

COAXIAL CABLE (concentric line)—a transmission line formed by two coaxial conductors, each insulated from the other by some suitable dielectric material such as air or polyethylene, polyfoam, teflon, etc.

COMMUNITY ANTENNA SYSTEM—a master antenna array and the signal distribution system, i.e., the amplifiers, coaxial cable, connecting devices etc., necessary to effect signal presentation at TV receiver

COMPATIBLE COLOR SYSTEM—a color television system which permits normal black and white reception of its transmitted signals without altering currently used receivers

CONTRAST—the relation of black to white on a receiver or projection screen

DECIBEL—a measure of the gain or loss of sound energy, intensity or loudness; each 3 decibel gain in sound measurement doubles the intensity or loudness

DEFINITION—the fidelity with which the detail of an image is reproduced by a television receiver; also called resolution

DEMODULATION—the process of removing the video and audio signals from their respective carrier waves

DIRECTIONAL ANTENNA—an antenna radiating or receiving radio waves more effectively in some directions than in others

FIDELITY—the degree to which a system, or a portion of a system, accurately reproduces at its output the essential characteristics of the signal that is impressed upon its input

FOOTCANDLE—a unit measure of quantity of direct illumination falling on a surface, measured from the surface toward the source

FOOTLAMBERT—a unit measure of reflected or emitted light "seen" by the viewer at the surface being illuminated

FREQUENCY—number of cycles per second

INTERFERENCE—disturbance in radio reception caused by undesirable signals or stray currents from electrical apparatus, atmospheric, static, etc.

INTERLACE—the process of scanning alternate lines of a television picture to reduce flicker

KINESCOPE RECORDING—a sound motion picture, usually on 16-mm. film, photographed off the end of a kinescope tube during a television show

LINE SCANNING FREQUENCY—the number or lines of an image scanned each second; under present U.S. standards it is 15,750 cycles per second, which corresponds to a 525-line picture

LIVE TALENT—studio or on-the-spot televising of events and people in contrast to the transmission of film material

LOCKED INTERLACE—a scanning system where the sweep frequencies used are rigidly timed and controlled. More stable in operation than random interlace

MASTER TV CONTROL—the point or points at which all TV signal assimilation occurs for subsequent controlled distribution through a closed circuit coaxial cable; this includes control of all inter communications signals, TV signals, etc.

MEGACYCLE (mc)—one million cycles; when used as a unit of frequency, it is equal to one million cycles per second

MICROWAVES—radio waves less than one meter in length

MICROWAVE RELAYS—systems used for transmission of video and audio signals by highly directional radio beams at frequencies between 2,000 and 15,000 mc.; distances up to 50 miles may be covered by a single link consisting of a transmitter and receiver; longer distances may be covered by multiple links receiving and transmitting the original signal

MODULATION—the process of impressing audio or video impulses on the carrier wave for transmission through the air

MONITOR—to control the picture shading and other factors involved in the transmission of both a scene and the accompanying sound; monitoring usually occurs in the control room and at the transmitter. Also denotes a type of receiver

MONOCHROME IMAGE ORTHICON—a television camera tube so sensitive it can televise (in black and white) any scene the eye can see, even under low lighting conditions; more expensive than vidicon, used for professional studio broadcasting; requires expert handling

MONOCHROME TRANSMISSION—the transmission of television signals which can be reproduced in graduations of a single color only (black and white)

MONOCHROME VIDICON—a television camera tube of moderate sensitivity, adequate for most educational broadcast requirements (black and white); much less expensive than image orthicon equipment; does not require highly expert handling

MULTIPLEXER—any device or circuit used for mixing signals; in television multiplexers have several applications, the most common of which is the optical mixing of several program sources such as film projectors, slide projectors, etc., for pickup by a single camera

NETWORK—a group of television stations connected by radio relays or coaxial cable so that all stations may simultaneously broadcast a program

PICTURE TUBE—the television cathode-ray tube used to produce an image by variation of the beam intensity as the beam scans the raster

PROJECTION TELEVISION—a combination of lenses and mirrors which projects an enlarged television picture on a screen

RADIO FREQUENCY—a frequency used for radio transmission; the present practicable limits of radio frequency are roughly 10 kc. per sec. to 100,000 mc. per sec.

RADIO WAVE—an electromagnetic wave produced by rapid reversals of current flow in a conductor known as the antenna, or aerial; such a wave travels through space at the speed of light, 186,000 miles a second

RANDOM INTERLACE—a scanning system based on the 2:1 interlaced broadcast standard which utilizes less precise timing of the sweep frequencies than that required for open circuit broadcast usage

RELAY STATION—a station used to receive picture and sound signals from a master station and to transmit them to a second relay station or to a television station transmitter

REMOTE PICKUPS—events televised away from the studio by a mobile unit or by permanently installed equipment at the remote location

REPEATER—a device for receiving, amplifying and re-transmitting a signal or wave

RESOLUTION—the blending of picture elements and lines; it may also be used to refer to the amount of detail present that can be resolved into a complete picture; a numerical value to express resolution may be determined by examination of a transmitted test pattern; the number of lines represented by the vertical wedges at their point of blending is the resolution in lines

REVERBERATION—persistence of sound in an enclosed space, due to reflection from the walls

SATELLITE STATIONS—VHF broadcast stations located within the area of service of another television broadcast station, licensed by the same ownership and intended primarily to repeat the same program to extend the service to an adjacent area; technical requirements are precisely the same as specified for regular license

SCANNING—the process of deflecting the electron beam in a camera or picture tube so that it moves at high speed from left to right in a sequence of rows or lines from top to bottom, thus changing light and shadows of a scene into electrical impulses to form the image on the receiver tube

SERVICE AREA—the region surrounding a broadcasting station in which that station's signals can be received with satisfactory results

SIGNAL—information transposed into electrical impulses; two basic signals involved in television transmission—the picture or video signal and the sound or audio signal; each signal contains electrical impulses representing elements transmitted

STUDIO CONTROL ROOM—the room or location where the monitoring equipment is placed for the direction and control of a television program

TELECAST—a broadcast of both sight and sound

TELEVISION—the radio or electrical transmission of a succession of images and their reception in such a manner as to give a substantially continuous and simultaneous reproduction of an object or scene before the eyes of a distant observer

TELEVISION BROADCAST SIGNAL—a combination of two radio frequency carriers spaced by 4.5 mc. per sec., the lower one being amplitude-modulated by a standard composite picture signal, the upper one being frequency-modulated by the accompanying audio signal

TELEVISION CHANNEL—the term "television channel" means a band of frequencies 6 megacycles wide in the television broadcast band and designated either by number or by the extreme lower and upper frequencies

TELEVISION RECEIVER—a receiver for converting incoming electric signals into television pictures and customarily associated sound

TELEVISION TRANSMITTER—the radio-frequency and modulating equipment transmitting modulated radio-frequency power representing a complete television signal (including audio, video, and synchronizing signals)

TRANSLATOR STATIONS—UHF broadcast stations also intended for repeat service to extend the service from an existing licensed station (ownership may be the same as the station used for program source); highly directional antennas are often utilized and a special set of operating and technical rules are followed, established by the F.C.C. but much different from standard broadcast requirements; the UHF channel so selected for translator service is based on availability and interference considerations

TRANSMISSION LINE—a material structure forming a continuous path from one place to another for directing the transmission of electromagnetic energy along this path

TRANSMISSION SYSTEM—in communication practice, an assembly of elements capable of functioning together to transmit signal waves

UHF—ultra-high frequency, normally about 300-3000 megacycles

UNIDIRECTIONAL ANTENNA—an antenna having a single well-defined direction of maximum radiation intensity

VHF—very high frequency, normally between 30 and 300 megacycles

VIDEO—of or concerning sight; specifically, those electrical currents representing the elements of a television picture

VIDEO AMPLIFIER—an amplifier having characteristics suitable for amplifying video signals

VIDEO SIGNAL—the frequencies generated by the scanning of a scene or image plus the sync and blanking pulses involved

References and Sources

The following are representative references used by the design group in the course of this EFL study, listed here for your use in further study of each subject area:

ASSOCIATIONS CONCERNED WITH EDUCATIONAL TELEVISION...

who will cooperate in furnishing both general and specific information regarding institutions using ETV, curriculum coverage, technical data, sources of counsel, etc.

Electronic Industries Association (EIA)
1721 Desales Street, Washington, D.C.

Federal Communications Commission
New Post Office Building, Washington 25, D.C.

Fund for the Advancement of Education—The Ford Foundation
477 Madison Avenue, New York 22, New York

Joint Council on Educational Television (JCET)
1785 Massachusetts Avenue, N.W., Washington 6, D.C.

National Association of Educational Broadcasters (NAEB)
14 Gregory Hall, Urbana, Illinois

National Education Association (NEA)
Department of Audio-Visual Instruction (DAVI)
1201 Sixteenth Street, N.W., Washington, D.C.

National Educational Television and Radio Center
10 Columbus Circle, New York, New York

U. S. Department of Health, Education and Welfare
Office of Education, Washington 25, D.C.

TELEVISION AND THE SCHOOL— GENERAL PRACTICE AS WELL AS TECHNICAL REFERENCE

An Analysis and Evaluation of a TV Demonstration of the Teaching of 5th Grade Reading, Arithmetic and French; The Board of Public Education, Pittsburgh, Pennsylvania, March-June 1957

Basic Television, B. Grob; McGraw Hill Book Co., 1954

"Broadcast Application Procedure", *INF Bulletin No. 1-B;* Federal Communications Commission, 1958

"Built-In TV for Teacher Training", Philip Lewis; *Chicago Schools Journal,* September-October 1954

The Chicago City Junior College Experiment in Offering College Courses for Credit via Open Circuit Television—A report of the second year of a three year project, Clifford G. Erickson and Hymen M. Chausow; Chicago City Junior College, April 1959

Closed Circuit and Industrial Television, E. M. Noll; The Macmillan Co., 1956

"Closed Circuit For You?"; Bulletins of General Precision Laboratory, Inc., October 1, November 1 and December 1, 1959

Closed Circuit Television Installation in Educational Institutions; Joint Council on Educational Television and Committee on Television of the American Council on Education, July 1958

Closed-Circuit Television—Teaching in Washington County 1958-1959; The Board of Education, Hagerstown, Maryland, March 1959

"Closed-Circuit TV", Richard Vanhoose; *School Management,* August 1958

Closed Circuit TV Systems Planning, M. A. Mayers and R. D. Chipp; John F. Rider Publisher, Inc., 1957

"College Teaching by Television", John C. Adams, C. R. Carpenter and Dorothy R. Smith; Report of Committee on Television of American Council on Education and Pennsylvania State University, October 1957

"Credit Courses by Television"; Report of Committee on Television of American Council on Education, Michigan State College, February 1955

Educational Teleguide; (FS 5.6/2: T 23); U.S. Department of Health, Education and Welfare, Office of Education, 1959

Educational Television Today—a Status Report; Joint Council on Educational Television, January 1959

Elements of Television Systems, G. E. Anner; Prentice-Hall, Inc., 1951

Essentials of Television, M. Slurzberg and W. Osterheld; McGraw-Hill Book, Co., 1956

Excerpt from Philco Closed-Circuit Television System Planning Guide; Philco Corp., Government and Industrial Division, 1959

Instructional Television Research; San Francisco State College, San Francisco, California, 1958

"An Investigation of Closed-Circuit Television for Teaching University Courses", Instructional Television Research, Report Number Two: The Academic Years 1955-1956 and 1956-1957, C. R. Carpenter and L. P. Greenhill; The Pennsylvania State University

The Milwaukee Experiment in Instructional Television—Progress Reports; Milwaukee Public Schools, 1957-58, 1958-59, 1959-60

The Milwaukee Experiment in Instructional Television—The Role of the Classroom Teacher, Elementary Level; Milwaukee Public Schools, July 1958

The National Program in the Use of Television in the Public Schools; Report on National Workshop, Chapel Hill, North Carolina, The Fund for the Advancement of Education, June 1959

New Frontiers in Learning, Lewis B. Mayhew; Stephens College, Columbia, Missouri, Educational Facilities Laboratories, Inc., 1959

The 1959 Educational Television Directory; Joint Council on Educational Television, January 1959

Partial transcript of proceedings of International Educational Television Seminar; Boston University, School of Public Relations & Communications; Division of Communication Arts, 1957

A Pilot Study of the Nature of Aesthetic Experiences Associated with Television and Its Place in Education, John B. Ellery, Ph.D.; Wayne State University, Division of Broadcasting, Detroit, Michigan, January 1959

Practical Television Engineering, S. Helt; Rinehart Books, Inc., 1953

Proceeding of Conference on Education—Television, under the Auspices of the Office of Education, in cooperation with National Association of Educational Broadcasters; U.S. Department of Health, Education and Welfare, Office of Education, 1958.

"Procedures for Improving Television Instruction", Otello L. Desiderato, Joseph H. Kanner and Richard P. Runyon; *Audio-Visual Communication Review*, Winter 1956

The Public Schools and Television; Florida State Department of Education, Distributor of Publications for the Southern States Work Conference, Tallahassee, Florida

Schools for Tomorrow: An Educator's Blueprint, Alexander J. Stoddard; The Fund for the Advancement of Education, 1957

Schooltime Study Guide; The Board of Public Education, Pittsburgh, Pennsylvania, 1958-59

Slides and Opaques for Television, No. S-5; Eastman Kodak Company, 1957

The Superintendent's Viewpoint on Educational Television—Hagerstown, Newton, Pittsburgh, Philadelphia, New York City; National Association of Educational Broadcasters, September 1958

"TV and the Crisis in Education", Paul A. Greenmeyer and Louis T. Inglehart; *Broadcast News*, October 1956

"TV's Exciting Developments", Philip Lewis; *Educational Screen and Audiovisual Guide*, May 1959

TV and Our School Crisis, Charles A. Siepmann; Dodd, Mead & Company, 1958

"The TV Teaching Center", L. L. Lewis; *AERT Journal*, January 1957

Teaching by Television; The Board of Public Education, Pittsburgh, Pennsylvania, 1956

Teaching by Television; The Fund for the Advancement of Education, May 1959

"Teaching by Television in the Army—an Overview", Joseph H. Kanner; *Audio-Visual Communication Review*, Summer 1958

"Teaching by Closed-Circuit TV"; Report of Committee on Television of American Council on Education and the State University of Iowa, February 1956

"Television in America's Schools"; *The Journal of Educational Sociology*, May 1959

Television in Army Training: Evaluation of Television in Army Basic Training, J. H. Kanner, Richard P. Runyon and Otello Desiderato; Department of the Army, Office of the Chief Officer, August 1958

"Television in the Classroom"; *The Nation's Schools*, October 1958

Television in Education, Franklin Dunham, Ronald R. Lowdermilk, and Gertrude G. Broderick; U.S. Department of Health, Education, and Welfare, 1958

Television Engineering, D. G. Fink; McGraw-Hill Book Co., 1952

Television Master Antenna Systems, I. Kamen and R. H. Dorf; John F. Rider Publishing Co., 1951

"Television as a Teaching Medium", P. A. Greenmeyer, A. F. Inglis, L. L. Lewis and V. S. Mattison; *College and University Business*, April 1957

"Television as a Teaching Tool", Robert M. Diamond; *Educational Screen and Audiovisual Guide*, June 1959

GENERAL EDUCATIONAL PRACTICE

The American High School Today, James B. Conant; McGraw-Hill, 1959

"Educating Talented Children in Elementary Schools"; *Education Briefs*, U. S. Department of Health, Education, and Welfare, Office of Education, November 1958

"Education—A Nation is Concerned", Lester W. Nelson; prepared talk to 2nd Annual Town Meeting, Citizens Committee on Public Education in Philadelphia, May 1959

Education As A Profession, Myron Lieberman; Prentice-Hall, Inc., 1956

The Future of Public Education, Myron Lieberman; University of Chicago Press, 1960

General Education in a Free Society, Report of the Harvard Committee; Harvard University Press, 1945

Graphic Communication and the Crisis in Education, Neal E. Miller, Yale University; National Education Association, Department of Audio-Visual Instruction.

Images of the Future—A New Approach to the Secondary School, J. Lloyd Trump, Commission on the Experimental Study of the Utilization of the Staff in the Secondary School; The National Association of Secondary-School Principals (NEA), 1959

"The Low Productivity of the Educational Industry", Daniel Seligman; *Fortune*, October 1958

Operation Education; Board of Education, Cleveland, Ohio

Penn State's Future . . . The job and a way to do it, The Administrative Committee on Long-Range Development; The Pennsylvania State University, University Park, Pennsylvania, January 1, 1958

"The Price of Progress", Randall M. Whaley; *Science Education News*, American Association for the Advancement of Science, June 1959

Psychological Research in Education, Report of Advisory Board on Education; National Academy of Science—National Research Council, 1958

"The Significance of Bowling Green", Randall M. Whaley; *NEA Journal*, National Education Association, April 1959

STATISTICAL REFERENCES

Statistical references used in this report were drawn from many sources. The authors are particularly indebted to the Director, Educational Statistics Branch, Office of Education, U.S. Department of Health, Education and Welfare for assistance in collating material from various source records. Additional references were drawn from the U.S. Department of Commerce, Bureau of the Census and National Education Association Research Reports.

SCHOOL PLANNING AND ARCHITECTURE

American School and University; Buttenheim Publishing Corporation, 1959-60

Architectural Forum, Special School Issue, November 1959

Flexible Classrooms, Russell E. Wilson; Carter Publishing Co., 1953

References and Sources *(continued)*

High Schools—Today and Tomorrow, Charles W. Bursch and John Lyon Reid; Reinhold Publishing Corp., 1957

The New School, Alfred Roth; Gemsbergdruck der Geschwister Ziegler & Co., Winterthur, 1950

Planning Elementary School Buildings, N. L. Engelhardt, N. L. Engelhardt, Jr. and Stanton Leggett; F. W. Dodge Corporation, 1953

"The 'Q' Space for Individual Learning", Charles W. Brubaker and Lawrence B. Perkins; *The School Executive*, February 1959

School Planning; F. W. Dodge Corporation, 1956

Schoolhouse, Walter McQuade, Editor; Simon and Schuster, 1958

Schools, Lawrence B. Perkins and Walter D. Cocking; Reinhold Publishing Corp., 1949

"Schools"; *Architectural Record*, November 1959 and February 1960

"Schools—A special 30-page report"; *Architectural Forum*, July 1956

Schools for the New Needs; F. W. Dodge Corporation, 1956

Secondary School Plant Planning, National Council on Schoolhouse Construction; The Council, Nashville, Tennessee, 1957

"Split-Level Classrooms for Beginners"; *The Nation's Schools*, June 1957

"Three Ace Schools for the Trump Plan"; *Architectural Forum*, March 1960

Toward Better School Design, William W. Caudill; F. W. Dodge Corporation, 1954

"TV and School Design"; *The NAEB Journal*, May 1958

Work Place for Learning, Lawrence B. Perkins; Reinhold Publishing Corp., 1957

ENVIRONMENTAL FACTORS: ACOUSTICS, LIGHTING, COLOR & VENTILATION

The A B C Plan for School Lighting; Lighting Division, Westinghouse Electric Corp., 1959

"Acoustical Properties of Carpet", Cyril M. Harris; *The Journal of the Acoustical Society of America*, November 1955

Acoustics Noise & Buildings, P. H. Parkin & H. R. Humphreys; Praeger Publishing Co., 1958

American Standard Practice for School Lighting; Illuminating Engineering Society, 19[illegible]

"The Case for Air Conditioned Schools"; Minneapolis-Honeywell Regulator Co., 1959

Color Planning for School Interiors, Department of Education, St. Paul Public Schools; Victory Printing Co., 1950

"Developing the Color Treatment for Schoolrooms", Paul W. Seagers; *Illuminating Engineering, June 1953*

"Economics of Classroom Lighting", Robert L. Zahour; *Electrical Construction and Maintenance, July 1955*

Functional Color for the Classroom, Paul W. Seagers and G. Harold Hart, ASID; Brunswick-Balke-Collender Co., 1958

Fundamentals of Light and Lighting, Walter Sturrock and K. A. Staley; Large Lamp Department of General Electric Co., January 1956

Less Noise—Better Hearing; The Celotex Corp., 1950

Making School Work Easier on the Eyes, Carl J. Allen; Lamp Division, General Electric Co., 1957

Management and the Worker, F. J. Roethlisberger and William J. Dickson; Harvard University Press, 1956

"New Measure for Light", David Allison; *Architectural Forum*, July 1959

"Recommended Levels of Illumination"; *Illuminating Engineering*, Illuminating Engineering Society, August 1958

Soundshear—a new principle of panel design; Bolt, Beranek and Newman, Inc., 1959

"What a Good Color Environment Can Do", William M. Pena; *Childhood Education*, Association for Childhood Education, December 1952

AUDIO-VISUAL TEACHING TECHNIQUES AND EQUIPMENT

Administering Audio-Visual Services, Carlton W. H. Erickson; The Macmillan Company, 1959

"Annual BLUE BOOK of Audiovisual Materials"; *Educational Screen and Audiovisual Guide*, August 1959

Art Work Size Standards for Projected Visuals, No. S-12; Eastman Kodak Co., 1957

Foundation for Effective Audio-Visual Projection, No. S-3; Eastman Kodak Co., 1957

"To Help Teachers Teach and Children Learn!", James M. Meagher; *Educational Screen and Audiovisual Guide*, January 1959

"Indiana Rules for AV Facilities", John Moldstad; *Educational Screen and Audiovisual Guide*, March 1959

"Instructional Materials Resource Center"; *Educational Screen* and Audiovisual Guide, May 1959

Legibility Standards for Projected Material, No. S-4; Eastman Kodak Co., 1954

Planning Schools for Use of Audio-Visual Materials, No. 1 Classrooms; National Education Association, 1958

Planning Schools for Use of Audio-Visual Materials, No. 2 Auditoriums; National Education Association, 1953

Planning Schools for Use of Audio-Visual Materials, No. 4 Audio-Visual Centers in Colleges and Universities; National Education Association, 1955

"The Roles of the Teacher and Student in the Electronic World", Myrtle B. McGraw; *Modern Language Journal*, May 1959

They See What You Mean—use of the overhead projector; Ozalid Audio-Visual Department, Division of General Aniline's Film Corp., 1959

HUMAN ENGINEERING

Children's Body Measurements for Planning & Equipping Schools, W. E. Martin; U.S. Department of Health, Education and Welfare, 1955

Dimensions of the Human Figure, L. W. Sahley; Cleveland Designers & Consultants, Inc., 1957

Handbook of Human Engineering Data; Tufts College, Institute of Applied Experimental Psychology, 1952

Human Engineering Guide, W. E. Woodson; University of California Press, 1954

MANUFACTURERS OF TELECASTING EQUIPMENT

Technical notes and references in this report are based in part on interviews and correspondence with the following sources. For a complete list of manufacturers of telecasting equipment refer to *TV Factbook.*

Adler Electronics, Inc.
New Rochelle, New York

Ampex Corp.
Redwood City, California

*Blonder-Tongue Laboratories, Inc.
Newark 2, New Jersey

*Dage Television (Div. of Thompson Ramo Wooldridge, Inc.)
Michigan City, Indiana

*Allen B. DuMont Laboratories, Inc. (International Division)
New York, New York

*Entron, Inc.
Bladensburg, Maryland

Gates Radio Co.
Quincy, Illinois

*General Electric Co. (Technical Products Department)
Syracuse, New York

*General Precision Laboratory, Inc.
Pleasantville, New York

*Jerrold Electronics Corp.
Philadelphia 3, Pennsylvania

Motorola, Inc.
Chicago 51, Illinois

*Philco Corp. (Government and Industrial Division)
Philadelphia 44, Pennsylvania

*Radio Corporation of America (Educational Electronics)
Camden, New Jersey

*Spencer-Kennedy Laboratories, Inc.
Boston 35, Massachusetts

*Sarkes Tarzian, Inc. (Broadcast Equipment Division)
Bloomington, Indiana

TelePrompter Corp.
New York 36, New York

*Closed circuit television system manufacturers

MANUFACTURERS AND ASSEMBLERS OF TELEVISION RECEIVERS

Technical notes and references in this report are based in part on interviews and correspondence with the following sources. For a complete list of manufacturers and assemblers of television receivers contact the Electronic Industries Association, Washington, D.C.

Admiral Corporation
Chicago 47, Illinois

Conrac, Incorporated
Glendora, California

Allen B. DuMont Laboratories, Inc.
Clifton, New Jersey

General Electric Company
Syracuse, New York

Magnavox Company
Fort Wayne 4, Indiana

*Motorola Inc.
Chicago 51, Illinois

Philco Corporation
Philadelphia 34, Pennsylvania

*Radio Corporation of America (Educational Electronics)
Camden, New Jersey

Sylvania Electric Products, Inc.
New York 19, New York

*Transvision, Inc.
New Rochelle, New York

Westinghouse Electric Corp. (TV Radio Division)
Metuchen, New Jersey

Zenith Radio Corporation
Chicago 39, Illinois

*Manufacture television receivers specifically designed for classroom use

MANUFACTURERS OF SPACE DIVIDERS

Technical notes and references in this report are based in part on interviews and correspondence with the following sources. For a complete list of manufacturers of space dividers refer to *Sweet's Architectural File.*

The Peele Company
Stewart & Flushing Avenues, Brooklyn 37, New York

Brunswick-Balke-Collender Company
The Horn Division, Kalamazoo, Michigan

Munchhausen Sound Proofing Company, Inc.
290 Riverside Drive, New York 25, New York

Torjesen, Inc.
209—25th Street, Brooklyn, New York

John T. Fairhurst Company
45 West 45th Street, New York 36, New York

For further information on the acoustic drapery material described and shown in sketches on page 51, contact Design Research, Inc., 420 N. Michigan Avenue, Chicago 11, Illinois.

OTHER PUBLICATIONS BY EDUCATIONAL FACILITIES LABORATORIES...

Here They Learn

EFL's first annual report, September 1959.

Ring the Alarm

A memo to the schools on fire and human beings, (some suggestions for principals and other school officials on the management of people to meet the emergency of school fires), November, 1959.

The Cost of a Schoolhouse

A review of the factors contributing to the cost and effectiveness of school housing, including planning, building, and financing, as well as the evolution of the schoolhouse and some conclusions regarding tomorrow's schools. To be available in May 1960.

Profiles of Significant Schools

A series of reports designed to make available information on some of the latest developments in school planning and design. *Profiles* available now are . . .

Wayland High School, Wayland, Mass.
Newton South High School, Newton, Mass.
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